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OF THE

AMERICAN ASSOCIATION OF NURSE ANESTHETISTS

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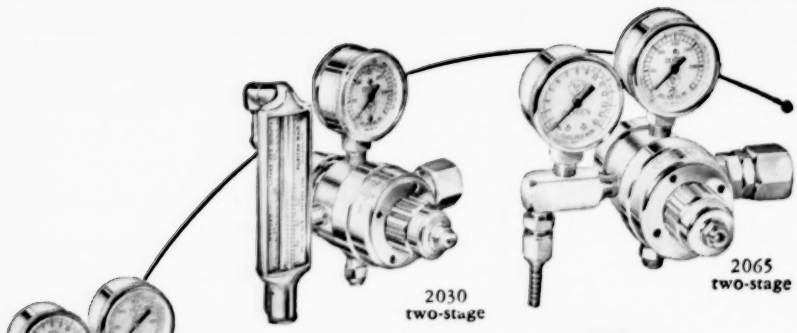

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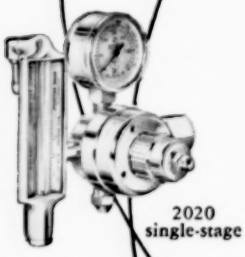

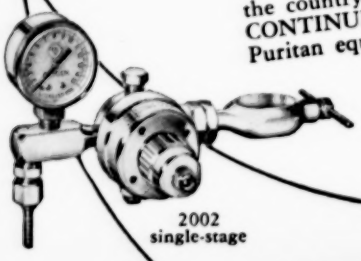

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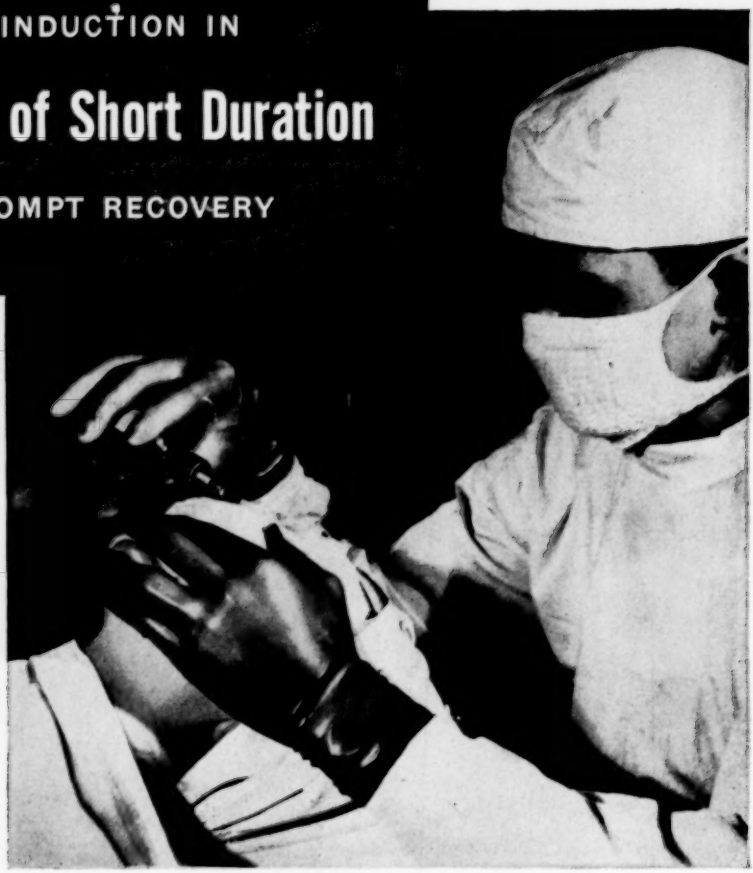

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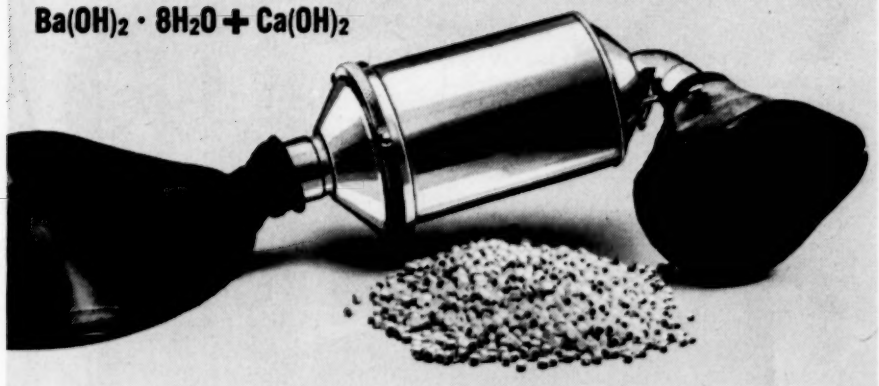

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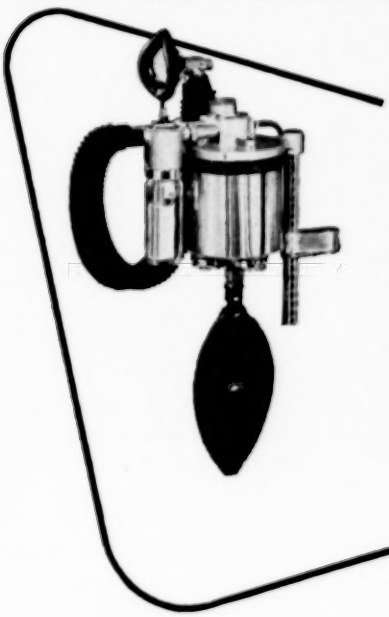

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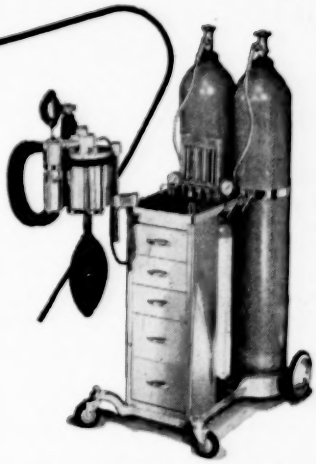

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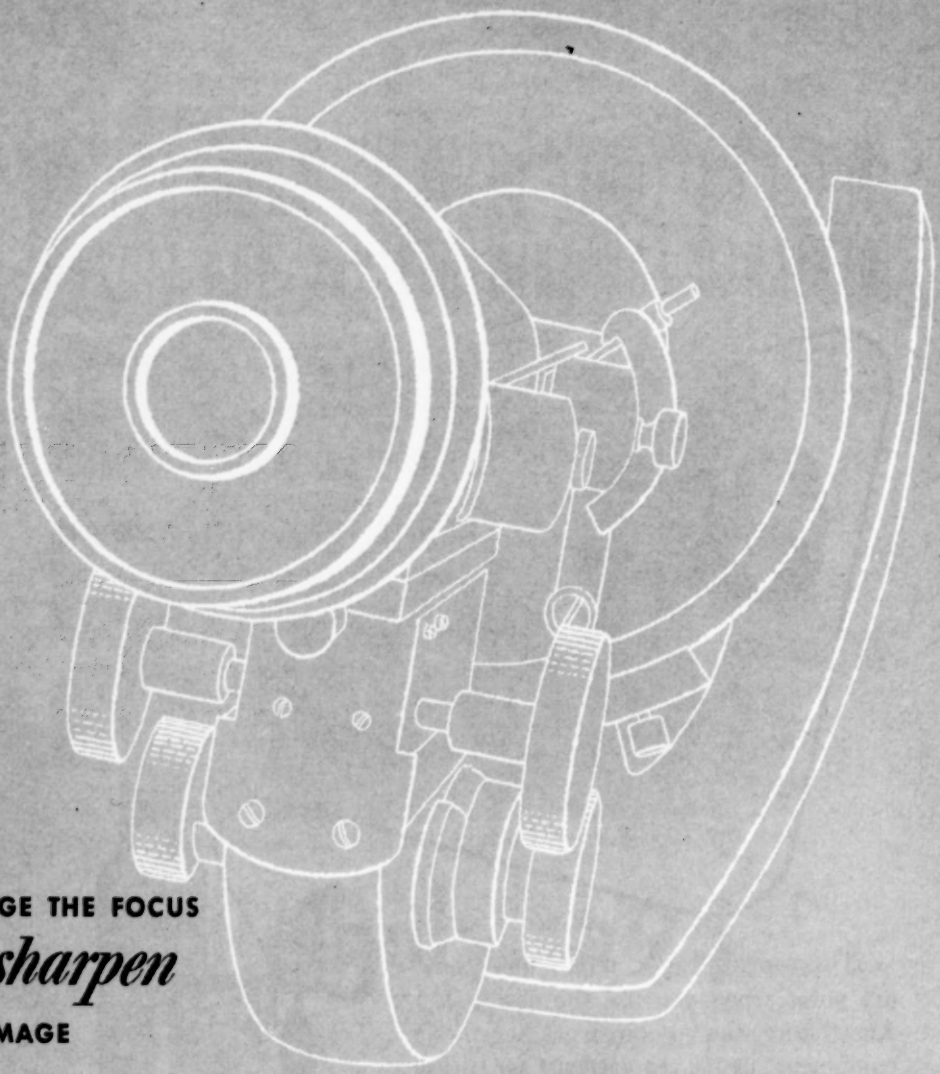

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THE IMAGE

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The Journal of the American Association of Nurse Anesthetists

VOLUME XIX NOVEMBER, 1951 NUMBER FOUR

THERE COULD BE A REASON

An arbitrary breakdown of what's wrong with the care of patients in hospitals would place most of the important criticisms in one of two categories: not enough people and not enough education. What confuses the issue is that to fill the ranks of the workers, not more but less education is called for, and in boosting educational requirements, not more but fewer workers are able to make the grade in dollars and cents, aptitute, and ambition.

During the Eighteenth Annual Meeting the members heard conflicting proposals about what sort of person should be the anesthetist of the future. There aren't enough anesthetists now, and the situation promises to get worse. So the profession must be made more attractive. It was said that the basic education of nurses in anesthesia should be at a university level and that such education should have the prestige inducements of offering credits towards a degree. It was also pointed out that patients have to be taken care of, and perhaps not even nursing training let alone advanced education was absolutely necessary to the person who administered routine anesthesia.

That nurses administer the majority of anesthesias today may not have been an entirely accidental or an entirely planned development. Potent social forces may have directed the specialty into its present channel. For disciplines that develop moral and ethical responsibility are no less essential to the care of patients than numbers of workers and scientific learning. The proving ground is the hospital, and at the time the physician as an intern is just beginning this rough phase in his development, the nurse has already passed through it. These hospital disciplines—of which nurses have so bitterly complained and which are such a strong factor in nursing custom—could well account for the fact that the nurse—rather than the physician or the lay person—has been the surgeon's choice for anesthetist in most instances.

Education in the sense of both broad and specialized knowledge forms the basis for the miracles of twentieth century medical care. At the same time, innumerable separate routines, requiring all grades of skill and training, contribute to the total care of the hospital patient. How much knowledge and how many skills are indispensable to any particular class of specialized worker is still being determined. And it is also an urgent question whether basic education is a legitimate hospital function. But not without peril can the disciplines that attend professional training in the hospital be dispensed with for considerations of facts and numbers.

THE CHALLENGE OF PULMONARY VENTILATION DURING ANESTHESIA

F. E. Leffingwell, M.D.*
Los Angeles

The human organism can live a few weeks without food, a few days without water, but only a few minutes without pulmonary ventilation. In the unnarcotized and unanesthetized person adequate exchange is maintained by reflexes initiated by changes in blood levels of carbon dioxide and oxygen. The patient under the influence of an anesthetic and some preliminary medication has been deprived to some degree of his normal responses to these stimuli and may thus suffer from hypoventilation unless the anesthetist comes to his aid. Thus the anesthetist literally has the patient's life in his hands by the narrow margin of a few minutes. At the outset then it becomes self evident that the most important function of the anesthetist is the maintenance of adequate ventilation.

Most anesthetists know and agree with this. However, many are unaware of the widespread violations of the principles of ventilation that result in some limitation of this important function. Have you ever heard snoring or stertorous breathing during anesthesia? Have you ever seen pentothal sodium administered without oxygen? Have you ever witnessed cyanosis during the administration of nitrous oxide? Then you have seen violations of the principles of which I speak.

Function of Respiration

The principal functions of respiration are well known: (1) the provision of the continuous supply of oxygen demanded by metabolic processes of the body and (2) the removal of carbon dioxide, which is a waste product of these same processes. The average adult at rest requires approximately 250 to 300 cc. of oxygen per minute to supply this demand, and the resulting carbon dioxide elaborated is only somewhat less. Adequate ventilation implies continuous maintenance of this oxygen supply and continuous elimination of the carbon dioxide; since neither of these functions can be interrupted for long without seriously threatening life, the responsibility of the anesthetist becomes at once apparent.

Exchange is brought about by rhythmic movements that are called respiration. The character of this respiratory act, that is, the depth and rate, indeed, the continuance of the very act itself,

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Read before the Western States Conference of Nurse Anesthetists, Los Angeles, May 1, 1951.

*Chief Anesthesiologist, White Memorial Hospital.

is dependent upon the blood concentration of the two gases involved—carbon dioxide and oxygen. Carbon dioxide is the most powerful respiratory stimulant known and acts upon the respiratory center, which is the most important reflex center controlling respiration. An increase in the concentration of carbon dioxide in the alveoli by as little as 0.1 per cent will double ventilation,[1] while a decrease in the concentration by the same amount will result in complete apnea. The immediate effects of oxygen want upon the respiration are not so pronounced but result in perhaps greater harm to the organism.

CAUSES OF RESPIRATORY DEPRESSION

As previously mentioned, most of what the anesthetist does to the patient tends to decrease the sensitivity of these reflex centers. Preoperative medication consisting of a barbiturate and a narcotic results in some depression of the respiratory center. Anesthesia may be induced or even maintained throughout with pentothal sodium, than which there is no more potent respiratory depressant. The addition of curare from time to time decreases respiratory efficiency by producing motor paralysis. The result is a degree of hypoventilation that will yield oxygen deficits and carbon dioxide excesses, which may not produce permanent damage but which certainly can account for many of the stormy postoperative reactions of the first few days.

Fortunately, the anesthetist has at his fingertips the means by which respiration can be controlled and adequate ventilation maintained. As is true in no other body system, departures from normal physiology can be prevented by the anesthetist, and damage resulting from such departures can be laid squarely at his door.

RESPIRATORY TRACT OBSTRUCTION

Cullen[2] made the statement that 90 per cent of anesthetic deaths result from mismanagement of the airway. Whether or not we agree with the exact figure Cullen cited, the observed instances of such mismanagement are so common and so numerous that it is worth while pointing them out. A patient is wheeled into the surgical amphitheatre by an attendant. The preoperative medication has relaxed his jaw and throat muscles, his tongue drops back, and the pharynx becomes so obstructed that every inhalation is made through a narrow aperture and with such resistance that merely a fraction of the normal oxygen intake is secured and this only at a wasteful expenditure of energy. With the patient on the table and the administration of the anesthesia started this condition may be corrected by an alert anesthetist, or it may be aggravated by further depression of the chin by a mask under pressure of a tight head strap. The signs of obstruction may not appear until induction is begun. Often administration of the first

1. Adriani, John: *The Pharmacology of Anesthetic Drugs* (Springfield, Ill.: Charles C Thomas, Publisher, 1942).

2. Cullen, Stuart C.: *Anesthesia in General Practice* (Chicago: Year Book Publishers, Inc., 1946).

few milligrams of pentothal sodium will bring about a sudden relaxation of the tongue and throat tissues and result in complete obstruction, which may go unnoticed until the patient is in an alarming state of anoxia. The relatively healthy patient will survive such an episode, but to the one with impaired cardiac function or partially occluded coronary arteries it might well mean the difference between survival and death. If the death occurs a day or two later, it is unlikely the blame will be placed on the anesthetist where it belongs.

Just how commonly can obstructed breathing be observed. Spend a morning in almost any operating pavilion, and the odds are great that you will see several such cases, ranging from a few minutes of mild stertorous breathing to the exaggerated situations just mentioned, which may proceed and be completely ignored throughout the entire anesthesia. For some reason many otherwise excellent anesthetists seem totally unaware of the problem of obstructed respiration, particularly minor obstruction. The first essential to the solution of a problem is its recognition. There is one simple criterion: *noisy* breathing is *obstructed* breathing. If the air passage is of sufficient diameter to permit adequate exchange, breathing will be noiseless. If harsh breath sounds can be heard, there is obstruction to an extent that should be relieved. Otherwise inaudible harshness resulting from minor obstruction may be detected by close application of the ear to one of the breathing tubes.

The causes of obstruction are legion: Relaxation of tissues of the neck, as already mentioned, is perhaps the commonest. Foreign bodies, such as regurgitated stomach contents, artificial teeth, and blood clots, may lodge in the lower pharynx or trachea and produce either a spasm of the larynx or actual mechanical occlusion. Tumors of the neck or vocal cords, substernal thyroid tissue, collapse of the trachea, or laryngeal edema may interfere with free exchange. An artificial airway is no insurance against obstruction. The tongue may be pushed ahead of the airway and the obstruction thus aggravated. The anesthetist should always make sure that the airway is properly placed so that it in itself will not act as an obstructing agent. A soft, much boiled airway may become kinked or compressed between spasmodic jaws. Airways have been inserted with lumens so occluded with dried blood or secretions as to be useless. All that has been said of airways may be said of intratracheal tubes with two or three additional precautions. Inserting an intratracheal tube of insufficient diameter is worse than having none in place at all. Because of their greater length and more pliable walls tubes are more prone to become kinked than airways.

Not all obstructions to respiration occur within the patient himself. Apparatus that is attached to the patient by airtight connections may be defective. Stiff valves and narrow apertures in connections or tubes, long narrow connectors, empty rebreathing bags, and caked or fine mesh soda lime all produce obstruction

and resistance to breathing, which are just as deleterious as a narrowed glottic opening.

While noisy respiration such as crowing, snoring, or wheezing always means obstruction, the reverse is not necessarily true. Not all obstructed breathing is noisy. If the obstruction is complete, there is no air passing; therefore there can be no sound. Also, if respiration is quiet and shallow, it may be nearly noiseless and yet be dangerously obstructed. The anesthetist should be alert, therefore, for the other signs of obstruction. Labored respiration, in which the efforts made in breathing are out of proportion to the motions of the rebreathing bag, should suggest the need for an immediate investigation. A gradual increase in blood pressure or a rapid pulse may be due to a variety of causes, but the anesthetist should think first of carbon dioxide excess or oxygen deficit and rule out these causes before searching elsewhere. Cyanosis may be seen in severe or prolonged obstruction, and if it is the first sign that is noted, the patient has certainly been neglected.

The question has been asked: "Why is snoring in the anesthetized patient so much worse than that occurring during normal sleep?" The answer is simple. During normal sleep a person's reflexes awaken him if the obstruction of normal snoring endangers respiratory exchange. The anesthetist deprives his patient of these protective mechanisms by narcosis and thereby takes unto himself the full responsibility for insuring adequate and continuous ventilation. The purpose of this article is a plea for more widespread recognition of that responsibility and greater care in its exercise.

PREMEDICATION AND HYPOVENTILATION

Hypoventilation may result from many causes other than obstruction. Decreased respiratory exchange resulting from sedation and anesthesia has already been mentioned. The average person has a normal tidal flow, or respiratory exchange, approximating 500 cc. Of this 500 cc. of inhaled air the first 150 cc. is that which resides in the air passage, being left there by the last exhalation. It has already been in the lungs and is therefore deficient in oxygen and heavily loaded with carbon dioxide. It is called dead air and serves no useful purpose in ventilation. The remaining 350 cc. of the inhalation is approximately 20 per cent oxygen. This means that each breath a person takes carries into the lungs about 70 cc. of oxygen. With a respiratory rate of 20 per minute, a minute volume exchange of approximately 1,400 cc. of oxygen is provided. This is many times the 300 cc. per minute required for average metabolic activity.

Now consider the surgical patient. Upon his arrival in the amphitheatre under the full effect of sedation, his tidal flow is usually decreased to 300 cc. or less. Dead air volume remains the same (150 cc.). This leaves a useful ventilating volume of 150 cc. of which 20 per cent, or 30 cc., is oxygen. Sedation has decreased not only his depth of excursion but also his rate of respiration to 12 per minute, which yields an oxygen minute volume exchange

of 360 cc. This is a very narrow margin even before anesthesia is started. If this patient is given a little pentothal sodium, it can be seen that without manual aid to his respiratory effort his oxygen intake will be deficient. These figures are not exaggerated but represent situations that occur daily, and only because the human organism is provided with tremendous reserves to cope with the environment can it come through such insults unharmed.

The obese, particularly the aged obese, patient requires especially close attention to the respiratory exchange. The next time you are confronted with a pear-shaped woman, weighing 200 pounds, to anesthetize, apply the mask connected to a gas machine with the rebreathing bag about half filled with oxygen; then administer a few cubic centimeters of pentothal sodium. If she is over 60 years of age, it is safe to predict that you will soon see a massive abdomen heaving like the waves of an angry ocean with little or no motion in the rebreathing bag. By checking the airway by compression of the rebreathing bag, a free exchange will be noted, and yet what appear to be exaggerated efforts at respiration on the part of the patient result in minimal exchange. A patient of this sort expends almost her entire effort in merely lifting the excessive weight of the fat-loaded viscera and the thick abdominal wall. No energy remains to motivate the respiratory act. Such a patient must certainly be given the relief of assisted respiration or suffer severe inadequacies of respiratory exchange.

Anesthesia and Hypoventilation

Practically every method or technic of anesthesia practiced, with the possible exception of regional block anesthesia, tends to reduce the patient's capability to ventilate himself. This does no damage provided it is recognized and corrective measures are instituted. With usual technics in premedication and the powerful depressant activity of the most commonly used anesthetic agents, it is the rare patient who escapes some hypoventilation if not given the benefit of manual aid with inspiration or an enriched oxygen concentration or both.

The patient under spinal anesthesia is no exception. Spinal anesthesia administered for an upper abdominal operation will paralyze most or all of the intercostal muscles. Many times spinal anesthesia will inadvertently reach high levels and even reduce the activity of the diaphragm. One of the earliest and most reliable signs of deficient respiratory exchange during spinal anesthesia or from overcurarization is the so-called tracheal tug, a gasping type of respiration in which the trachea and the chin are depressed with each inspiratory effort. Whenever that occurs and as long as it exists, it is certain that the patient is suffering from oxygen want and from carbon dioxide accumulation. This sign must not be ignored. The patient should be assisted with each respiratory effort, and the tracheal tug will disappear when adequate ventilation is instituted and maintained.

POSITION AND HYPOVENTILATION

Hypoventilation may result from external restrictions, such as tight binders, bandages, tightly tucked in restraints, and other positioning aids. A patient held in position with a snug, 2 inch band of adhesive tape across the chest might find breathing difficult even if he were awake. When the patient has received sedation and is anesthetized, such an aid to positioning becomes a definite hazard. A patient should be anchored in a lateral position with adhesive tape bands across the pelvis and shoulder girdle, never across the chest or abdomen. An alert anesthetist will pointedly nudge the elbow of a tired assistant when it leans heavily upon the patient's chest or trachea. If one nudge doesn't suffice, it may be repeated p.r.n.

The unnatural position imposed upon a patient by exaggerated elevation of a gallbladder or kidney lift may seriously encroach upon the respiratory excursion. The co-operative surgeon will promptly yield to the suggestion of his anesthetist that a modified use of the lift would result in more normal physiology for the patient. If the surgeon is known to be obdurate, a surreptitious lowering of these devices of torture is justifiable if the patient shows the need for it. No surgeon to my knowledge has ever been hampered in his work and none has been aware of the change in position if it is brought about gradually.

The prone position is particularly likely to result in deficiencies of respiratory exchange. It is frequently difficult or even impossible to place the head in a position that will provide a completely patent airway. For that reason, intratracheal intubation is advisable whenever general anesthesia is administered to a patient in this position. Furthermore, the patient in the prone position must lift the weight of his body with each inspiratory effort unless sandbags or supports are so placed as to permit relatively free movement of the thoracic cage and abdomen. Many pieces of apparatus have been devised to achieve this end, but if such are lacking, the patient should be supported principally on the iliac crests and shoulder tips by properly placed and padded sandbags.

RESULTS OF HYPOVENTILATION

The physiologic and pathologic changes resulting from violations of these principles are numerous. As the thoracic cage expands during inspiration, the lungs expand so as to completely fill the thoracic cavity. Air rushes in to fill the enlarged and expanded air spaces within the lungs. This is true only if the airway into those spaces is unobstructed. If there is obstruction to the entry of air, negative pressure results within the alveoli. If this condition persists long enough, fluid begins to enter the air sacs from the tissue of the lungs and the pulmonary capillary bed. This is caused by the mechanical effect of the negative pressure within the alveoli, plus the increased permeability of capillary walls resulting from anoxia. The result is pulmonary edema. Unless corrected by the prompt restoration of positive pressure within the lungs and an increase in the

oxygen intake, death will occur. From a practical standpoint, obstruction of the airway means slow induction and poor maintenance of anesthesia, because the anesthetic drug does not readily pass into the lungs. The resistance to forcing air through the narrowed aperture of an obstructed airway calls for an unwarranted expenditure of energy, which rapidly exhausts even the robust patient.

The damage done by oxygen want is too well known to require discussion here. Not so readily recognized are the harmful effects of carbon dioxide retention. As has been pointed out, carbon dioxide is a powerful stimulant to the respiratory center, which is extremely sensitive to minor changes in the blood level of this waste product. The initial result is overstimulation and a hyperpneic response in an effort to eliminate the excess carbon dioxide. Continued stimulation soon produces fatigue of the respiratory center and later actual depression, with the production of a gasping type of respiration. If the accumulation becomes excessive, twitching of muscles or actual convulsions may follow.

Since effective pulmonary ventilation requires the elimination of carbon dioxide from the body, there must be some means of removing it from the respiratory stream when rebreathing technics are used. Only if the total flow rate is 6 to 7 L. per minute can the problem of carbon dioxide absorption be safely ignored. The technical features of carbon dioxide absorption with soda lime could well be the subject of another article, but in passing it seems appropriate to mention one or two common errors in this connection.

Increasing hyperpnea during inhalation anesthesia calls for an examination of the absorption system. Exhausted soda lime is the most common cause of nonabsorption. While the life of a canister of soda lime varies considerably depending upon the conditions under which it is used, it is worth while to keep a record on the outside of the canister to indicate roughly how much use it has had. The indicators used in soda lime give only an approximate idea of the condition of the surface of a particular granule at the time of inspection. A mass of soda lime that appears exhausted one moment may look different two hours later. It should be remembered, however, that soda lime is relatively inexpensive, and in case of doubt the canister should be recharged with fresh material. The best index is the patient's response to such a change. The flutter valves should always be checked; one of them may be stuck so as to produce a bypassing of the soda lime. It should be remembered that as long as the patient is alive, carbon dioxide is pouring into his alveoli at the rate of about 200 cc. or more per minute; this must be eliminated as rapidly as formed if serious alterations in physiology are to be prevented.

The necessity for guarding the patency of a patient's airway doesn't end at the conclusion of the anesthesia. A walk through the postoperative recovery ward after a busy morning in the surgery will show how many cases

(Continued on page 250)

GERIATRIC ANESTHESIA

Sister M. Reginella, R.N.*
Chicago

The study of aging as a process has been conspicuously neglected until recent years. Biologists and physicians have been strangely content to take the phenomenon of aging as a matter of course. For centuries the philosophers and poets seemed to be the only ones interested in the aged. The ancient Greeks held their aged seers in great reverence, but this was due in part to the fact that in those days the very old were objects of curiosity because of their rarity.

The cornerstone of the growing structure of knowledge concerning aging and the aged lies in the fact that elderly people are not just "old people"; they are structurally, functionally, and mentally different men and women than they were in the days of their youth and early maturity.

The increase in the average life expectancy from 50 years to 60 years at the present time has resulted in a pronounced increase in the amount of surgical treatment given to persons of advanced years. Many of these persons are victims of the degenerative diseases, such as cardiovascular disorders, cancer, rheumatism and arthritic conditions, diabetes, trauma, tuberculosis, anemia, and disorders of the genitourinary tract. Deficiencies in calcium, iron, and vitamins are frequent causes of the weakness and enervation that wear the aging body.

When surgical treatment is indicated for an elderly patient, the possibilities of complications from anesthesia produce greater fear in the minds of the patient and the surgeon than that produced by the operation itself. Friendly conversation with the patient will reveal the hidden fears that he harbors concerning surgery and anesthesia.

Among aged patients the factors contributing to a good or poor surgical risk include constitutional changes, greater resistance to infection when the person is in fairly good general health and considerably lowered resistance when the body is debilitated, susceptibility to surgical shock, slowed reaction from shock, slow and incomplete repair, deleterious after-effects and local changes, degeneration, atrophy, increase in proportion of inorganic salts in bone rendering the bones more brittle, cardiac and respiratory tract degeneration, and increased danger from anesthesia.

In choosing anesthesia for a particular patient five points

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must be considered in order to control these factors: (1) evaluation of the patient, (2) premedication, (3) choice and methods of anesthesia, (4) supportive measures, and (5) immediate postoperative care.

Evaluation of the Patient

Age itself cannot be classified as a disease, even though chronic invalidism causes a dissipation of life energy for many elderly patients. In contrast to being chronic invalids, many persons seem to get a "second wind" at age 60 or later and enjoy the exuberance of a second adolescence.

There is an increase in the incidence of apoplexy, pulmonary emboli, hypertension, thrombotic processes, coronary occlusion, and occluded vessels of the extremities in these patients. Too much emphasis cannot be placed on the careful checking of all the medical data pertinent to the individual patient, such as the electrocardiogram for the study of the heart function, urea clearance and concentration test to determine the adequacy of the kidneys, and the liver function test for the determination of the status of the liver.

Tests for the amounts of sugar and nonprotein nitrogen in the blood should always be made to ascertain whether or not a mild diabetes is present and to check further upon the kidney function. No patient should be considered for anesthesia until blood and urine studies are complete and until an examination of the cardiovascular and respiratory systems has been made. The presence of hepatic or renal disease, prevalent among the elderly patients, modifies the choice of anesthetic procedures.

The psychologic status of the patient should likewise be taken into account. An old, alert person who wants to get well is a better surgical risk than one who is apathetic and resigned.

Premedication

It is desirable that the patient undergoing surgical treatment be given premedication to allay fear, lessen reflex activity, control pain—if present—, and diminish salivation and secretions of mucus.

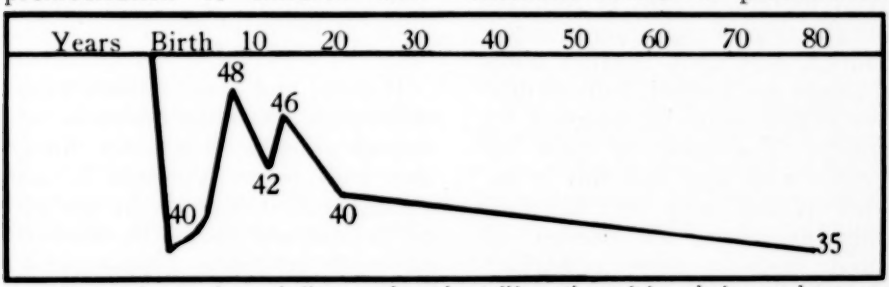
Administration of preanesthetic sedation should be started the night before the operation, since a good night's rest before operation is essential for old people. The administration of a short-acting barbiturate, such as seconal or nembutal, gr. ¾ or 1½, at bedtime the night before the operation and again during the night for restlessness, if necessary, is sufficient to provide the desirable rest for the aged patient who is not in pain. Should the patient be in pain, the barbiturate should be supplemented with an intramuscular injection of demerol, 50 mg.

The metabolic rate, that is, the total oxygen consumption, should be the criterion for determining the dosage administered. If the oxygen consumption could be measured just before the sedative is given, the suitable dose could be arrived at very accurately. Practically, one must depend upon a considered evaluation of a combination of such factors as age, size, occupation, habitual

activity, recent activity, muscle tone, hemoglobin, appetite, recent loss of weight, confinement, pain, and the recent necessary use of sedatives and analgesics.

The ultimate determination of dosage depends on the patient's level of reflex irritability. This level of reflex irritability parallels fairly constantly the metabolic activity. The metabolism of each patient varies with his age. The most important single factor influencing the estimation of the level of reflex irritability, and therefore the tolerance to depressant drugs, is the patient's age.

Variation of metabolism with age is illustrated in the chart. It shows that from a given value at birth the metabolic activity increases sharply to 6 years of age, at which point it recedes slightly, then rises again at puberty, after which it gradually declines until old age. The chart delineates the reason for the frequent underpremedication of children and the overpremedication of the aged.



Curve of normal metabolic rate throughout life, estimated in calories per hour per square meter of body surface. The curves of oxygen demand and reflex irritability are exactly parallel.

The bland preanesthetic analgesics, which have been most effective in the aged, are, in the order of their safe effectiveness: (1) codeine, gr. 1 (64 mg.), (2) pantopon, gr. ½ (32 mg.), (3) demerol, gr. ¾ (50 mg.). It must be remembered that the drugs used for premedication may greatly alter vascular dynamics, respiratory activity, and metabolism.

The effects of morphine sulfate on elderly patients are unpredictable. It produces depression out of proportion to the expected effect.

Codeine has been useful in many instances.

Demerol, a new synthetic analgesic, is the drug of choice for premedication for elderly patients. It has a sedative effect equivalent to that of morphine, and its analgesic potency is rather high, while at the same time it possesses definite antisecretory properties. Depression of respiration or of other vital functions is less than with comparable amounts of morphine, while unfavorable side reactions, such as nausea and vertigo, are less frequently observed. Demerol proves to be an excellent choice for patients suffering from chronic asthma, as it possesses desirable spasmolytic properties. This feature is highly valuable inasmuch as the asthmatic patient suffers from chronic hypoxia, and the administration of morphine—even during a mild paroxysm—may terminate fatally.

Although the barbiturates are

valuable drugs for sedation, it must be ever kept in mind that they have no analgesic properties and as a group are respiratory depressants. Their effect is often prolonged because of lessened permeability of the kidney in the aged. However, many authorities contend that the administration of barbiturates is indicated when spinal or local anesthesia is used because of their prophylactic action in combating the toxic effects of the anesthetic agents. But here again the dosage should be reduced.

The belladonna drugs inhibit secretions and in so doing tend to prevent aspiration phenomena. They obviate or minimize untoward vagal reflexes, such as laryngospasm, which sometimes occur when pentothal sodium or evipal is used.

Less sedation and less anesthesia are often needed by the geriatric patient because vitality is lowered in senescence, the basal metabolic rate is reduced, and the rate of excretion of drugs is often decreased. Smaller doses of drugs are needed, and cumulative effects must be watched for closely. Tolerance to pain increases with age, and this is another reason why less sedation and anesthesia are needed. A noted surgeon once remarked, "Age is its own anesthetist."

Choice and Method of Anesthesia

With the introduction of new agents and methods of anesthesia in recent years the range of choice of anesthesia has widened so that we cannot say unreservedly that any procedure is best for a given operation. The first and most important principle is to choose the anesthesia that will offer to the patient the greatest safety and assure him, as far as possible, an ultimately complete recovery. The factors to be considered in achieving this objective are: (1) the skill and experience of the anesthetist, (2) the effect of the anesthesia on the pathologic condition present, (3) the production of ideal operating conditions for the surgeon, and (4) the choosing of a method that is psychologically suited to the individual patient.

In the elderly patient the circulatory system has lost many of its compensatory mechanisms through arteriosclerosis and degeneration. Pulmonary disease is frequently present. Emphysema is not uncommon with reduction of vital capacity and impairment of alveolar exchange. A patient with emphysema has a more or less fixed thoracic cage; for adequate exchange of gases he depends upon the accessory muscles of respiration.

Hepatic and renal tissues have undergone variable amounts of degeneration with lowered function and reserve. Anemia is not an unusual finding in the geriatric patient and should be corrected with adequate blood transfusions before operation. Transfusions should be continued during the operation, if necessary. The anesthetist must keep in mind the lack of resiliency of the vascular system in the aged, which prevents rapid adjustment to changes in blood pressure or blood volume. Sudden increase in blood pressure from excessive or over-rapid infusions may produce pulmonary edema. A de-

crease in blood pressure, especially if sudden or prolonged, gives rise to circulatory insufficiency, which, in turn, activates a chain of events with which the vessels cannot cope. Hypotension is inclined to set off the fatal train of thrombosis, embolism, infarction, and anoxemia. Therefore the maintenance of normal blood pressure is most important if these dangers are to be avoided.

Another distressing problem in the elderly patient is the extreme operative position, such as the Trendelenburg, lithotomy, prone horizontal, high gallbladder, or kidney, which interferes with circulation and respiration.

PENTOTHAL SODIUM

Pentothal sodium given intravenously is gaining rapidly in favor and provides satisfactory anesthesia. It may be used successfully for operations of short duration and also in conjunction with general, local, regional block, and spinal anesthesia. The onset of unconsciousness is rapid and pleasant.

It should not be used, especially for the aged, in operations requiring much relaxation. It produces respiratory depression and is toxic in large doses. Since many elderly patients suffer from hypertension, the anesthetist must be cautious in the administration of pentothal sodium. When this agent is used, the blood pressure of a patient with hypertension decreases more acutely than that of the patient who has a normal blood pressure. After the initial dose of pentothal sodium the blood pressure may decrease about 30 to 60 mm. Hg. The return to the preoperative level may not take place so quickly as in a normal patient. A patient in shock is also more likely to have an acute decrease in blood pressure when pentothal sodium is used. Furthermore, particular care must be taken not to give a patient an overdose of drugs, such as pentothal sodium, that are excreted unchanged.

As a preliminary to other agents, pentothal sodium is very useful and adds comfort in that the apprehension experienced in the state of wakefulness or induced by the application of a mask and smothering sensations can be eliminated before administration of the gas is started.

INHALATION ANESTHESIA

Inhalation anesthesia affords a variety of agents and technics. Whatever the choice, adequate oxygenation must be provided at all times. Rapid induction free from excitement is highly desirable, while the least possible interference with normal physiology, both during and after operation, is imperative.

Nitrous oxide is the poorest of all anesthetics for the aged, since a low oxygen concentration must be maintained to produce anesthesia. Its ability to produce relaxation is poor. Without supplementary anesthesia it should not be administered to geriatric patients. After unconsciousness is induced with pentothal sodium, nitrous oxide—if administered with sufficient oxygen, as in a mixture of 50 per cent nitrous oxide and 50 per cent oxygen—is the safest general anesthetic available.

Ethylene is highly recommended as an anesthetic for old people

in a variety of procedures of medium and minor difficulty. Since it is slightly more potent than nitrous oxide, the oxygen concentration can be somewhat increased, and with the aged one wishes to maintain a high oxygen level.

Many consider cyclopropane the ideal agent for the aged since it has the advantages of rapid and smooth induction and prompt recovery. Its potency allows the simultaneous administration of plenty of oxygen. Cyclopropane is nonirritating to the respiratory tract, but it must be remembered that it increases myocardial irritability and thereby arrhythmias. It stimulates the vagus, causes bradycardia, and produces bronchoconstriction. According to some authors, its administration to a digitalized patient is not recommended because digitalis increases the irritability of the cardiac muscle. Others claim it may be given to patients on a digitalis regimen, although it has a parasympathetic action, providing the heart rhythm is regular and one is prepared to change the agent should irregularities appear.

Certain cardiac irregularities do develop under cyclopropane anesthesia, but these usually occur in the light planes of surgical anesthesia and are abolished when the depth of surgical anesthesia is increased. It is the consensus at the present time that, if certain types of arrhythmias occur, the introduction of a little ether into the anesthetic mixture will usually abolish these cardiac irregularities. The prolonged administration of cyclopropane should be watched carefully, because of the fact that the systolic blood pressure, which has a tendency to be reasonably well maintained during surgical anesthesia with this agent, tends to decrease rather abruptly after the administration of cyclopropane is terminated. Not infrequently the patient enters into a state of hypotension that may reach the level of surgical shock within a few moments. Cyclopropane should not be used for a patient suffering from disease of the coronary arteries, because this agent causes a constriction of blood vessels.

Ether has been satisfactory in the past and is still a widely used agent. It should be employed in small amounts as an adjuvant because it is a depressing and debilitating drug. Alterations in blood pressure are minimized, and there is usually some increase in the heart rate due to the specific action of the agent. Coronary arteries are dilated, assuring better nutrition to the heart. Its outstanding advantage is in the possibility of using large amounts of oxygen and maintaining a stable blood pressure.

Ether is contraindicated in the presence of acute nephritis and should be employed cautiously in the presence of chronic renal disease. If extensive liver damage is present, other agents should be employed. In uncontrollable diabetes the use of ether is best avoided since its use occasions a decrease in insulin production and an increase in glycogenolysis. Such a condition enhances the possibility of superimposing a diabetic coma upon the unconsciousness of anesthesia.

When used in large amounts,

ether leaves the patient fatigued and devitalized during the days following the surgical operation. The after-effects of ether, such as liver damage, postoperative vomiting, and acidosis, are poorly tolerated by patients in the advanced age group.

REGIONAL ANESTHESIA

Regional nerve block and local infiltration anesthesia, alone or in combination with other forms, have a definite place in anesthesia for geriatric patients. There are many advantages to regional over other types of anesthesia for the aged patient. Regional anesthesia causes less disturbance of the respiratory or the circulatory system than any other type. It causes little damage to the liver, does not disturb the oxygen-carrying power of the blood, and has almost no effect on the myocardium. It does not increase tissue anoxia in shock. Complications such as vomiting, laryngospasm, respiratory depression, and respiratory obstruction, so often encountered during general anesthesia, are absent. The technic is simple but time consuming; it imposes upon the surgeon the need for patience and gentleness.

Regional anesthesia may be used alone or in combination with very light pentothal sodium anesthesia in order to secure muscular relaxation without the aid of toxic volatile drugs, to diminish capillary oozing, and minimize reflex shock.

Lest regional block anesthesia be adopted too widely, it must be recognized that the incidence of reactions to local anesthetic agents is increased in the aged, that tissue irritation from the drug may interfere with tissue repair, and that supplementation of an inadequate block may be attended with the hazards of excitation, vomiting, and the aspiration of gastric contents into the tracheobronchial tree.

SPINAL ANESTHESIA

Spinal anesthesia affords a desirable means of providing anesthesia for geriatric patients in the presence of the most serious physical states without any considerable added hazard if precautions and contraindications are faithfully observed. The use of this method should not be undertaken except by those having a thorough understanding of all its aspects.

The chief difficulty is the high incidence of inelasticity in the circulatory system so that it does not adjust well to physiologic upsets that tend to cause changes in the blood pressure. The tissues of an old person, notably the heart muscle and brain, are especially susceptible to damage by anoxia and the risk of thrombosis attendant upon acute hypotension, and the small vessels are particularly susceptible to the strain of hypertension.

The level of anesthesia necessary for a proposed operation should be a determinant in evaluating the safety of spinal anesthesia. In perineal and low abdominal operations, as well as in operations on the lower extremities, spinal anesthesia appears to be well tolerated by elderly patients.

The choice of the drug for spinal anesthesia will be influenced by the type and duration

of the operation and by the experience and preference of the anesthetist.

Frequently, supplementary agents are resorted to in connection with spinal anesthesia. The most commonly used is pentothal sodium, 0.1 per cent, administered by the drip method. It induces sleep and controls reflexes such as those stimulated by traction in the upper abdomen. In many instances pentothal sodium, with oxygen and nitrous oxide in 50 per cent mixtures, is used to permit the administration of more oxygen and to assist in keeping the patient asleep.

Use of Curare

Curare in its purified form is helpful in providing adequate relaxation with the use of a minimal amount of anesthetic agents. The only dangerous complication of its use is respiratory depression or arrest; therefore it is preferable to administer curare in divided doses. Every anesthetist using curare should make adequate preparation for the establishment of a patent airway and the maintenance of artificial respiration. Physostigmine and neostigmine are physiologic antagonists to curare and act immediately to relieve respiratory paralysis induced by it. However, since these drugs increase bronchial secretions, atropine should be administered concomitantly.

A word of caution should be given concerning the use of curare to secure relaxation during closure of the abdomen. In certain persons, especially the aged, who have received curare for this purpose, a transient depression of respiration occurs after the closure of the abdomen. This is probably due to the fact that sensory and motor stimuli are no longer present, and respiration is not reflexly activated by these stimuli. Consequently, it is important to watch the patient closely when he is returned to his room to make sure that an adequate airway is maintained and that adequate pulmonary ventilation continues.

The use of pentothal sodium intravenously, supplemented by nitrous oxide, 50-75 per cent, and oxygen, 50-25 per cent, in analgesic doses, with the addition of curare in small divided doses, proves to be useful and an excellent combination for old people. This is one of the greatest recent advances in anesthesia. The airway, however, must be kept patent at all times by the insertion of a pharyngeal airway or an intratracheal tube. Anesthesia suitable for any operation may thus be maintained with the subsequent awakening of the patient in good condition.

Supportive Measures

To support the aged patient undergoing surgical treatment it is important to provide for adequate replacement of fluids and for oxygen therapy. The judicious administration of fluids overcomes dehydration and helps the vascular system to accommodate itself to minor fluctuations in volume of the circulating blood incident to change in blood pressure. Blood loss is poorly tolerated by patients of advanced years; consequently, blood should be replaced as it is lost to prevent irreversible shock.

Oxygen should be used freely during anesthesia as well as postoperatively. John B. Dillon of Los Angeles made the remark that "blood and oxygen are two of the most valuable tools which the anesthetist has to support the aged patient through the ordeal of surgical treatment."[1]

POSTOPERATIVE CARE

The postoperative period and the innumerable sequelae stemming from the anesthesia and the operative procedure are unappreciated by many. The handling of patients immediately after operation should be gentle; any roughness or sudden movements may precipitate shock. After the patient's reflexes are fully active, he should be encouraged to move about in bed and never maintain one position for any long period. Early ambulation is a marked advance in the postoperative care of these patients.

Continuous observation by capable personnel of the pulse, blood pressure, airway, color, temperature, dressings, position, and over-all appearance of the patient is essential. Preparedness to counteract at a moment's notice the effects of vomiting is of obvious value. Fluids must be available for administration in the immediate postoperative period. There is always the danger of giving too much fluid and salt. Restlessness may be due to hypoxia; oxygen given postoperatively may relieve it.

The use of analgesics should be reduced to an absolute minimum or avoided when possible. They usually diminish the useful cough reflex and depress respiration and movement. Excessive use of sedation may make the patient so drowsy that he fails to take adequate fluids and nourishment. It may cause mental symptoms suggestive of dementia.

Care should be given to the maintenance of body warmth. Deep respiratory excursion may prevent pulmonary complications. Carbon dioxide inhalation is advocated, for it stimulates deep respirations that help to eliminate the anesthetic agents and may help to expel mucus plugs.

SUMMARY

Adequate preoperative preparation of geriatric patients is today recognized as one of the fundamental principles to be observed carefully if morbidity and mortality are to be kept at a minimum. The judicious use of premedication is of vital importance, since the aged patient can tolerate well only reduced quantities of premedicants and anesthetic agents. Anoxia and shock must be prevented, and proper fluid balance maintained. At times the immediate postoperative care of elderly patients is critical, so proper care is essential to them and early mobilization strongly encouraged.

As is true of the administration of any anesthesia, it is even more so of the administration of anesthesia to old people that the things that matter most are not the drugs to be used but the skill, care, and experience with which they are given and with which the case as a whole is handled.

1. Dillon, J. B.: Anesthesia for the aged. J.A.M.A. 135:977-981, Dec. 13, 1947.

PREOPERATIVE PREPARATION AND POSTOPERATIVE CARE

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and

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The preoperative preparation of the surgical patient begins at the time the patient is first notified of the need for an operation. This preparation in modern medical practice should be the joint responsibility of the surgeon, an internist or general practitioner, and the anesthesiologist. The anesthesiologist may no longer be considered as a "hired hand" to carry out the surgeon's orders but must be considered as part of a team whose duty it is to conduct the patient through the surgical experience as safely and as easily as possible.

The postoperative care of the patient begins at the time the anesthesia is concluded. Again the anesthesiologist has an integral part in making sure the patient has every chance for an uncomplicated recovery.

It has been these recent improvements in preoperative preparation and postoperative care that have aided greatly in reducing morbidity and mortality.

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It is our aim in this article to point out to you only the more important problems in preparing patients for general surgical procedures and the more common problems encountered in postoperative care. We have had an opportunity to perform operations in many hospitals during the past few years. Some of these hospitals have been large institutions and medical centers, while many have been small county-seat hospitals. We draw many of our conclusions from this experience.

PREPARATION OF THE PATIENT

A complete physical examination and essential laboratory studies should be made on every patient undergoing an operation. On the basis of this examination the preoperative plan is drawn up. If the operation is simple, it may be unnecessary to go to great lengths in this preparation, whereas if it is complicated and extensive, many days may be required and considerable effort may be spent by the surgeon and the referring physician in preparing the patient for the procedure.

Patient interview.—The anesthetist and the surgeon should always keep in mind that a surgical operation and an anesthesia

are usually new and fearful experiences to most patients. Therefore it is important that adequate time be given to the psychologic management of the patient in an attempt to relieve his fears. Frequently these "fears" of anesthesia are merely hearsay and not based on facts.

Premedication. — Premedication schedules *must never* become routine but should be individualized in every instance. Premedication properly used may make the difference between an easy safe anesthesia and a rough dangerous procedure.

Proper premedication should produce amnesia, decrease fear and apprehension, decrease reflex irritability, decrease secretions of the respiratory tract and the mouth, and decrease metabolism and thereby decrease the amount of anesthetic agent necessary. This medication should be given far enough in advance of the operation to obtain its full effect before the patient goes to the operating room. If this is not possible by the usual oral, subcutaneous, or intramuscular route, the intravenous administration of the medication, which gives a rapid effect, may and should be used.

Morphine or demerol, atropine or scopolamine, and barbiturates are the usual preanesthetic drugs in common use. Morphine or demerol is used for its analgesic and sedative effect. Morphine may be given to adults in doses of gr. 1/8 to 1/4 (7.5-15.0 mg.) one to one and a half hours before operation.

Atropine or scopolamine is used for its amnesic effect, its inhibiting effect on the parasympathetic system, and its effect of mild respiratory stimulation. These drugs may be given in doses of gr. 1/200 to 1/100 (0.32-0.64 mg.) one to one and a half hours before operation.

H.M.C. no. 1, containing morphine, gr. 1/4, and scopolamine, gr. 1/100, or H.M.C. no. 2, containing morphine, gr. 1/8, and scopolamine, gr. 1/200, may be used to replace morphine or demerol and atropine.

Barbiturates, such as seconal or nembutal, gr. 1 1/2 (90.0 mg.), may be given the night before operation to produce rest and decrease apprehension, and the dose should be repeated one and a half to two hours before operation to produce amnesia.

ANESTHETIC AGENT

The ideal anesthetic agent was described by Seevers and Waters[1] as meeting the following requirements: The *patient* needs a rapid, pleasant, nonirritating anesthetic that will produce freedom from discomfort during the recovery period; the *surgeon* would like a nonexplosive agent capable of producing complete relaxation without increasing bleeding; the *anesthesiologist* wants an anesthetic with a wide margin of safety, which is excreted unaltered from the body, causes a minimum of functional or organic injury, and is potent enough so that it can be combined with a high percentage of oxygen; and the *manufacturer* must have an agent that can be easily produced and purified and that will not deteriorate during storage.

No one agent will fulfil all these criteria, and the anesthesi-

1. Seevers, M. H., and Waters, R. M.: Pharmacology of anesthesia gases. Physiol. Rev. 18:447, July 1938.

ologist must know the advantages, applications, and limitations of each in order to prevent accidents and complications and thus produce a safe easy anesthesia.

POSTOPERATIVE CARE

The postoperative care of the patient begins at the time the anesthesia is concluded. We feel that ideally a patient should be responding before he leaves the operating room. It is our feeling that adequate postoperative care may save many lives, and that each patient must be treated individually. At no time should "routine orders" be given for postoperative care.

The postoperative care of the surgical patient may depend upon the condition of the patient during the operation. The following few rules should be constantly kept in mind in preventing complications: (1) Avoid obstruction to the airway to prevent hypoxia. (2) Avoid excessive trauma to vital structures and thereby reduce disturbances of the heart, lungs, and brain. (3) Replace blood and fluids during the operation only as needed. (4) Observe meticulous hemostasis to prevent postoperative hemorrhage or hematomas. (5) Observe careful anatomic closure of all incisions to avoid wound dehiscence. (6) Do only the surgery necessary—NO MORE.

Neglect of these rules may lead to any of several complications.

Cardiac arrest.—Each of the authors of this paper has had an occasion in the past year to treat this problem. We believe that many cases of cardiac arrest can be blamed on hypoxia and/or reflex vagal stimulation. The survival of the patient depends upon the immediate recognition of this condition by the *anesthetist* and the immediate institution of cardiac massage and chemical stimulation or chemical inhibition of the heart and immediate delivery of pure oxygen to the patient's lungs by the anesthetist. For the chemical stimulation a solution of 1:1,000 epinephrine should be used, and for the chemical inhibition in cases of fibrillation a solution of 1 per cent procaine with a small amount of epinephrine should be used. We believe that these solutions should at all times be available in the operating room for immediate use.

Atelectasis.—Postoperative atelectasis may frequently be avoided by recognition of early preatelectatic signs before the patient leaves the operating room. The surgeon nearing the completion of the operation may note that the blood is moderately dark, whereas the anesthetist may be giving almost pure oxygen at this time. The patient has no noticeable obstruction to his airway, and his blood pressure and pulse may be good. This is a warning that should never be disregarded or neglected.

At the conclusion of the operation careful examination will reveal barely noticeable cyanotic tinting of the nail beds or the skin of the forehead. An immediate examination should always be made of the lung fields, and usually an area of *absent* breath sounds is noted, most frequently in the right lower lobe posteriorly. This indicates a "plugged" bronchus and should be treated immediately.

The treatment consists of aspiration of the trachea by catheter and hyperventilation, and, if the patient is responding from the anesthesia, coughing should be produced by pounding the patient on the back until the lung is clear. Following this treatment with its usually dramatically good results, the patient should be placed in bed with the affected side uppermost to prevent splinting.

Shock.—The anesthetist should inform the surgeon of any sign of impending shock. This is recognized by a decrease in blood pressure and an increased pulse rate. The treatment entails the intravenous administration of fluids and chemical stimulation as well as a change in the depth of anesthesia.

Laryngospasm.— Cyclopropane and pentothal sodium are the two agents that most commonly produce sensitization of the larynx, thus paving the way for laryngospasm. These two drugs also have a constricting effect on the bronchial musculature. Adequate premedication consisting of morphine, atropine, barbiturates, and antihistaminic drugs, such as pyribenzamine (25-50 mg.) or benadryl (25-50 mg.), reduces the likelihood of laryngospasm and produces greater and freer gaseous exchange. The antihistaminic drugs at this time are being studied by some of our own anesthetists[2] with the preliminary impression that they help increase the drying effect of atropine or scopolamine and counteract the bronchoconstricting effect of pentothal sodium, cyclopropane, and curare. They believe that all patients receiving cyclopropane, pentothal sodium, or curare have some degree of bronchial constriction, and thus these antihistaminic drugs may prove to be just the answer to this problem. These anesthetists likewise feel that the patients receiving antihistamine medication require less anesthetic agent to produce adequate anesthesia.

2. Love, G. N., and Cohn, A. F.: Personal communication to the authors.

THE RECOVERY ROOM

In large institutions and even in small hospitals a recovery room is ideal, and more hospitals are adopting this plan each year. The recovery room plan allows one experienced nurse easily to supervise and care for several patients who are recovering from anesthesia and naturally adds to the safety and efficiency of the care during this critical period. A good recovery room should be located near the surgery and should be equipped with all drugs and apparatus necessary for emergency treatment of patients recovering from anesthesia and for the treatment of early complications noted during the recovery period.

Some of the more important items needed in this recovery room are: (1) tracheotomy sets, (2) aspiration equipment, (3) inhalation equipment (hyperventilation sets and oxygen sets), (4) venesection sets, (5) plasma and fluids, (6) intravenous sets, (7) blood pressure apparatus, and (8) narcotics for use when the patient is awake.

EARLY POSTOPERATIVE CARE

The following early postoperative treatments are a few of the more important needed for patients undergoing anesthesia.

Deep breathing exercises should be a "must" to help relieve the body of residual anesthetic agents and to prevent atelectasis by collections of bronchial secretions.

Frequent turning and elevation of extremities immediately after the patient arrives in his room may do much to prevent hypostatic pneumonia and thrombophlebitis.

Blood pressure, pulse, and respirations should be checked at frequent intervals on patients recovering from anesthesia, and this is particularly a "must" for patients recovering from long anesthesia or a rigorous operation. These may serve as a warning of impending or present shock and respiratory difficulty.

Tracheal aspiration should be performed if there is evidence of secretions present in the trachea.

Oxygen should be given for respiratory difficulty, hypoxia, and cyanosis.

Hyperventilation may be used to aid in the elimination of anesthetic agents by stimulating respiration.

Blood, plasma, or fluids should be given intravenously only as needed. Many patients do not need intravenous administration of fluids after an operation, whereas others may need judicious fluid replacement. We have seen complications of stasis pneumonia and edema result from the overzealous routine postoperative administration of fluids.

SPECIAL POSTOPERATIVE TREATMENTS

Special postoperative treatments may be needed, and the following discussion covers some of the more important items used in modern surgical practice. Many of these are of particular interest to the anesthetist.

Intercostal injections.—Intercostal injection of procaine is frequently a valuable postoperative treatment for those patients who have had upper abdominal operations. Narcotics have been and still are invaluable agents for controlling pain immediately following operations. However, they have undesirable side effects that are depressant in nature. Heavy sedation in the early recovery period may only further embarrass the process of respiration, bowel activity, and micturition, which are already burdened by a surgical procedure. Intercostal injections appear to decrease the need for these agents in the recovery period.

We have been using intercostal blocks successfully for some time on patients undergoing gallbladder operations particularly. Pontocaine in 0.15 per cent solution is injected in the fourth to the sixth interspace, posterior, in amounts of 5 cc. to each interspace. We have had no untoward results from this medication, and we feel that over half of these patients have had remarkable relief from postoperative pain due to the injection. This is evidenced by the remarkable decrease in the patient's need for narcotics during the first forty-eight hours.

Narcotics.—Narcotics are used to relieve pain as soon as the patient has responded from the influence of the anesthetic. We feel that we should caution against the many respiratory tract complications that are due to the too early administration of narcotics

to patients recovering from anesthesia.

Stigminene bromide.—Stigminene bromide (Warner) is a synthetic prostigmine-like drug. We have used this drug in almost all cases of abdominal surgery, either the first or second day postoperatively, to prevent or relieve ileus, gas pains, and inability to void. We have had great success in reducing the incidence of catheterization and postoperative gas pains. The drug's action is much smoother and more constant than that of prostigmine. Many patients have noted relief from postoperative nausea when placed on a course of stigminene bromide.

Levine tube.—Certain operative procedures require the use of a Levine tube with suction as a means of preventing postoperative discomfort and complications.

Chemotherapy.—We are not advocates of routine postoperative chemotherapy but believe that sulfonamides, penicillin, and the "mycin" drugs should be used only as indicated.

Early ambulation.—We believe that early ambulation has reduced the incidence of postoperative complications markedly and has hastened the return of the normal physiologic functions of the body. We feel that wound healing is improved and the incidence of wound dehiscence decreased by early ambulation.

Intravenous alcohol.—Intravenous administration of alcohol in surgery is in its infancy, and its value still must be proved by time. However, a solution of ethyl alcohol, protein hydrolysate, and dextrose in water appears to be a valuable agent for relieving pain and discomfort and for minimizing the amount of opiates or similar agents needed to control pain in the immediate postoperative period. It has been used immediately after operation to promote comfort and amnesia. Later an additional intravenous infusion of 1,000 cc. of the solution is given if pain occurs at the incision site. This usually provides analgesia for a further period of eight to twelve hours.

When alcohol-protein-dextrose solution is used for analgesia, respiratory depression does not occur. The incidence of catheterization, headache, nausea, and gas pains is reduced by the postoperative intravenous use of the solution.

Preliminary reports indicate that this preparation contains sufficient calories to provide complete nutritional requirements for the average patient postoperatively.

The solution used consists of 7.5 per cent ethyl alcohol, 5 per cent protein hydrolysate, and 5 per cent dextrose in 1,000 cc. of water.[3]

SUMMARY

We have attempted to outline some of the major problems in the preoperative preparation and the postoperative care of the surgical patient. We have briefly mentioned our concept of the proper care of the surgical patient as practiced in large institutions and small hospitals. We have tried to discuss only the practical aspect of preoperative preparation and postoperative care of the surgical patient as related to anesthesia.

3. Grabill, F. J.; Hockmuth, L., and Tuohy, E: The intravenous use of alcohol in surgery. Anesth. & Analg. **29**:211, July-Aug. 1950.

INDICATIONS AND CONTRAINDICATIONS FOR GENERAL ANESTHESIA IN OBSTETRICS

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The proper approach to this subject presented to a group of anesthetists should be by way of digression. Any discussion of obstetric anesthesia naturally brings up analgesia, as often patients who have a precipitate or nearly precipitate labor receive only analgesia. Analgesia also serves as premedication for obstetric anesthesia.

The ideal agent for analgesia or anesthesia for obstetrics has yet to be found. The principles set forth by Fluhman[1] in 1940 hold true today. They are that: (1) The ideal agent must alleviate suffering, not interfere with the progress of labor, and be safe for the baby. (2) One must be familiar with the agent and know its contraindications. (3) One must know the proper dosage and optimal time for administration.

With these principles in mind let us review some of the more prominent drugs employed during the past few years.

MORPHINE

Morphine is probably the most widely used drug. It is fast acting and analgesic and does not interfere with labor unless given in large doses. Some fetal narcosis will be present if morphine is administered within three to four hours of delivery. It is of particular value for the patient with toxemia of pregnancy or cardiac disease.

MORPHINE-SCOPOLAMINE

In 1902 VonSteinbuckel[2] used this combination, and it later came to be known as twilight sleep. Many babies in deep narcosis were lost. However, administered properly the method is of particular value for long tedious exhaustive labors and allows the patient to rest and awaken refreshed so that she can go on to a happy termination.

HEROIN

This is a good drug, but it is not obtainable.

DEMEROL®-SCOPOLAMINE

Demerol® or demerol in combination with scopolamine is an excellent drug, which because of its usefulness often lulls one into

Read before the Twelfth Annual Meeting of the Mississippi Association of Nurse Anesthetists, Biloxi, May 16, 1951.

1. Fluhman, C. F.: Analgesia and anesthesia in obstetrics. West. J. Surg. **48**:361, 1940.

2. Titus, Paul: *Management of Obstetric Difficulties*, ed. 3 (St. Louis: C. V. Mosby Co., 1945).

a false sense of security. Its action on the uterus is similar to that of morphine, but it appears to be less toxic. Schadel[3] used this drug with terminal pudendal block anesthesia with excellent results.

DOLOPHINE®

Dolophine® is a new drug that proved disappointing in Lund's[4] study.

BARBITURATES

These drugs include a large class of compounds of similar action. They share one disadvantage, that is, to achieve amnesia large doses administered orally are needed, and to attain analgesia nearly lethal doses are necessary. The critical dosage for the baby is far less than that for the mother. Patient excitement is usually great. Barbiturates have some value if rest is desired in lengthy and slowly progressing labor.

INTRAVENOUS ANALGESIA

The drugs used for intravenous analgesia include pentothal sodium, evipal, vinbarbital sodium (Delvinal®), dial urethane, and paraldehyde.

Pentothal sodium has all the disadvantages of the barbiturates as a class. In cesarean section it is of value in providing relaxation of the mother after delivery of the baby. Hellman and his coworkers[5] showed that within ten to twelve minutes the concentration of the drug in the child is equal to that in the mother.

The action of evipal is similar to that of pentothal sodium.

Vinbarbital sodium may be administered orally or intravenously. It was used by Kohl,[6] and Lewis and Boddie[7] for 3,150 patients. The incidence of operative intervention in the series was 53 to 57.5 per cent. Asphyxia was present in 11.6 to 18.9 per cent of the infants, and after delivery the mothers slept from one to eighteen hours, often to the alarm of the family.

A dose of 4 cc. dial urethane intravenously when the cervix was dilated 2 cm. was used by Van Del[8] in 2,000 deliveries. Morphine, gr. $1/8$, was given one half hour later. No narcosis was noted in the infant, probably because of early administration of the drug.

Paraldehyde was given intravenously to 100 patients by Gardner and Sage[9] and found not to be satisfactory.

RECTAL ANALGESIA

The Gwathmey technic enjoyed wide use in some centers and is still used by a few. The original formula was quinine alkaloid, gr. 20, alcohol, minims 45, ether, ounces $2\frac{1}{2}$, and olive oil sufficient to make 5 ounces. A variation of the formula consists of substituting mineral oil for olive oil and leaving out the quinine. The odor

3. Schadel, L. M.: A method of obstetrical analgesia and anesthesia. Am. J. Obst. & Gynec. **55**:1016, 1948.
4. Lund, C. J.: Choices of analgesics during the first stage of labor. J.A.M.A. **145**:1114, 1951.
5. Hellman, L. M.; Shettles, L. B.; Manahan, C. P., and Eastman, N. J.: Sodium pentothal anesthesia in obstetrics. Am. J. Obst. & Gynec. **43**:851-860, 1944.
6. Kohl, M. F. F.: Intravenous vinbarbital sodium for obstetrical analgesia. Am. J. Obst. & Gynec. **56**:811, 1948.
7. Lewis, M. S., and Boddie, J. B., Jr.: Vinbarbital sodium for obstetrical amnesia, analgesia, and anesthesia. South. M. J. **41**:820, 1948.
8. Van Del, D. T.: Intravenous dial urethane in obstetrics. J. Missouri M. A. **39**:100, 1942.
9. Gardner, H. L., and Sage, E. C.: Intravenous administration of paraldehyde during labor. Am. J. Obst. & Gynec. **42**:467, 1941.

of ether rapidly gets on the baby's breath.

Evipal was used rectally in 705 deliveries by Anderson[10]; 5 per cent of the patients were difficult to manage. The dose was 1.5 Gm.

Sigmodal enjoyed some popularity in 1939. Sleepy babies were the result.

Paraldehyde was reported by Colvin and Bartholomew[11] to be used with good results. In 500 deliveries 12 per cent of the babies were sluggish.

Analgesic Drugs Combined With Stimulants

With the combination of caffeine and pentobarbital sodium the babies are somewhat less sluggish than when pentobarbital sodium is used alone.

Nicotinamide was used in 159 consecutive labors under barbiturate-scopolamine anesthesia, and considerably fewer babies required resuscitation.

Scopolamine-apomorphine was given 500 patients by Hershenson and Brubaker[12] following an initial dose of seconal, gr. 3. Scopolamine, gr. 1/100, and apomorphine, gr. 1/100, were given as a first dose, using scopolamine, gr. 1/150, and apomorphine, gr. 1/50, every two hours. Vomiting occurred in 24.5 per cent of the cases, excitement in 21 per cent, and there were no appreciable increase in blood loss and no demonstrable depression of either full term or premature babies even when the medication was given shortly before delivery.

Inhalation Anesthesia

Ether is low in cost and easy to administer, and the mortality rate with its use is low. Deep relaxation may be obtained by the use of ether alone or in combination with anesthetic gases. When ether is used alone, induction is lengthy, and it is a counterirritant. Operative vaginal deliveries not requiring uterine relaxation can be well handled with the patient under open drop ether anesthesia. Oxygen may be insufflated under the mask so that the degree of hypoxia of the infant is decreased. Ether can also be used when deep planes of anesthesia are required. When version or other forms of intrauterine manipulation require deep anesthesia to assure adequate relaxation of the uterine musculature, ether has no equal.

Vinyl ether, or Vinethene, is excellent when a short procedure is anticipated, as the induction period is short. It can also be used for induction prior to the administration of drop ether for maintenance.

Nitrous oxide is popular for analgesia early in labor, but is poor when long or deep anesthesia is needed, because of the low oxygen content in an effective anesthetic mixture.

Chloroform is easily portable and inexpensive. It can be self administered and is often used for terminal delivery in the home. The danger of liver damage and death following its use was reported in early series of cases, and for this reason it has

10. Anderson, H. E.: Combined evipal and scopolamine analgesia and cyclopropane in obstetrics. Am. J. Obst. & Gynec. **53**:758, 1947.
11. Colvin, E. D., and Bartholomew, R. A.: Improvements in paraldehyde method of relief of pain in labor. Am. J. Obst. & Gynec. **35**:589, 1938.
12. Hershenson, B. B.: Premedication and anesthesia in obstetrics, practical aspects. Anesthesiology **9**:73-85, Jan. 1948.

not been so extensively used in recent years. It is contraindicated in the presence of toxemia and for patients with hepatic or cardiac disease.

With proper premedication ethylene is a good agent, as high concentrations of oxygen can be used with it. Recovery is rapid. If deep anesthesia is required, ether must be added to the anesthetic mixture.

The rapid induction and the possibility of providing high oxygen concentrations in cyclopropane anesthesia are of value. Relaxation is good. The concomitant use of atropine controls laryngospasm, and irritation to the respiratory tract is minimal. The training of the anesthetist is very important when cyclopropane is used.

CONTRAINDICATIONS FOR GENERAL ANESTHESIA

According to Dyer[13] general anesthesia is contraindicated for the obstetric patient with coronary occlusion, angina pectoris, congestive heart failure, or syphilitic aortitis, for the mortality rate is high. In the presence of valvular heart disease uncomplicated by myocardial involvement almost any form of anesthesia may be used. In thyrotoxicosis administration of an abundance of oxygen is desirable. In the presence of upper respiratory tract infection or bronchitis gas anesthesia is best avoided, spinal or local anesthesia being preferable. Severe preeclampsia contraindicates general anesthesia, and the use of pudendal block anesthesia is advised. This is also true for the patient with acute poliomyelitis or active tuberculosis.

During active labor delayed gastric activity with prolonged gastric retention makes the danger of aspiration of vomitus an important factor in the selection of the type of anesthesia. Recent ingestion of solid food or a large amount of liquids should lead the choice away from general anesthesia. Deaths due to aspiration of stomach contents are constantly appearing in the literature.

The search for painless childbirth has led many obstetricians far into the field of anesthetic agents, but so far the search has not been rewarded by the discovery of the ideal drug. When the expectant mother asks, "What do you give during labor?" and then answers the question for you with, "I don't care just so I know nothing about it," the physician should have a vision of a dusky blue, limp newborn who just will not take a breath. I do not think Grantley Dick Read had the answer for these women, but a course down the middle of the road is much better for all concerned. The temptation to give large doses of analgesics or anesthetics is so great, especially to the woman who complains out of proportion to her discomfort, that the child of such a mother is usually deeply narcotized.

Orkin and Rovenstine,[14] in discussing some of the basic principles of obstetric analgesia and anesthesia, reported that it has

13. Dyer, Isadore: Analgesia and anesthesia in obstetrics. New Orleans M. & S. J. **102**:309, 1949.

14. Orkin, L. R., and Rovenstine, E. A.: Obstetrical analgesia and anesthesia. **M. Clin.** North America **35**:805, 1951.

long been recognized that the fetus lives in a state of asphyxia intolerable to the newborn in spite of the increased oxygen-carrying capacity of the blood. Separation from the mother and the placenta makes it mandatory that respiration be instituted rapidly—generally speaking, within ninety seconds—or mechanically assisted or artificial respiration be used. The baby carrying a high concentration of a drug used to alleviate the mother's pain will be sluggish and will often present the obstetrician with a problem that at best has a gloomy outcome. Snyder[15] in his intrauterine studies found that pain-relieving drugs produced depressant effects upon fetal respiration and increased the incidence of asphyxia neonatorum. Of the anesthetic agents studied by Snyder only cyclopropane could be used for surgical anesthesia without depression of fetal respiration.

Prolonged asphyxia, intrauterine or extrauterine, may cause pathologic changes discernible in the later life of the individual. Courville[16] and Yant[17] showed that the central nervous system is the most sensitive to hypoxia. Schrieber,[18] Darke,[19] and Preston[20] independently studied series of cases in which the mental retardation of children was traced back to anoxic episodes during delivery. The brain is affected from the higher centers downward, with the cortical cells being the most sensitive. No one can calculate the number of geniuses who have been smothered or the number of normal individuals who may have been transformed by well meaning obstetrician-anesthetist combinations.

So far I have said nothing of the indications for general anesthesia, as the indications parallel closely the indications for any operative procedure. The use of midforceps, the need for rotation in posterior presentation, or the need for version or for breech extraction requires relaxation of the uterus and consequently deeper planes of anesthesia. Tetanic contraction of the uterus or the presence of Bandl's ring requires deep anesthesia for relaxation, and ether is recommended.

SUMMARY

The various anesthetic agents used in obstetrics and their relative merits are discussed. The qualifications of an ideal anesthetic and the deficiencies of those mentioned are listed. The value and dangers of chloroform, the advantages of ether and cyclopropane with their limitations, and the preference for demerol-scopolamine as an analgesic are pointed out. The contraindications for general anesthesia in obstetrics are also delineated. The occurrence of narcosis in the newborn and its dangers are emphasized. Finally, the indications for general anesthesia are listed as such.

15. Snyder, F. F.: *Obstetric Analgesia and Anesthesia.* (Philadelphia: W. B. Saunders Co., 1949).
16. Courville, C. B.: *Untoward Effects of Nitrous Oxide Anesthesia* (Mountain View, Calif.: Pacific Press Pub. Assn., 1939).
17. Yant, W. P., et al: Public Health Bull., No. 211, 1934.
18. Schrieber, F.: Apnea of the newborn and associated cerebral injury. J.A.M.A. 111:1263, 1938.
19. Darke, R. A.: Late effects of severe asphyxia neonatorum. J. Pediat. **24**:148, 1944.
20. Preston, M. I.: Late behavioral aspects found in cases of prenatal, natal, and postnatal anoxia. J. Pediat. **26**:353, 1945.

COMPLICATIONS OF ANESTHESIA

A meeting of the Institute for Nurse Anesthetists convened at 9:00 a.m., Friday, February 23, 1951, at the Jefferson-Hillman Hospital Auditorium, Birmingham, Ala., with Florence A. McQuillen, R.N., presiding as chairman. Participants were: Dr. John Adriani, Director, Department of Anesthesia, Charity Hospital of Louisiana, New Orleans; Alberta Boggan, R.N., Chief Nurse Anesthetist, Jefferson-Hillman Hospital, Birmingham; Dr. John M. Bruhn, Medical College of Alabama; Helen Lamb, R.N., Director of School of Anesthesia, Barnes Hospital, St. Louis; Dr. Alice McNeal, Chief, Department of Anesthesiology, Jefferson-Hillman Hospital, Birmingham; and Dr. E. B. Robinson, Jr., Director of Anesthesia, Lloyd Noland Hospital, Fairfield, Ala.

MISS MCQUILLEN: The first question is: **What is the best type of anesthesia for a patient 80 or 90 years old who enters the hospital in shock, has a blood pressure of 70 mm. Hg systolic and 50 mm. Hg diastolic, has an acute condition of the abdomen, has had a recent coronary occlusion, and is emaciated and feeble. On admittance to the operating room the patient's blood pressure was 100 mm. Hg systolic, and the pulse rate was 76 a minute.**

We will ask each of our speakers to express an opinion on this question.

DR. ADRIANI: I believe that if the operation could be done under local anesthesia, it would be the anesthesia of preference; an abdominal field block can be done on this type of patient and would be the first choice.

I would certainly not use spinal anesthesia or cyclopropane. Because of its effect on the heart, cyclopropane would be contraindicated. While I wouldn't be afraid to use cyclopropane, cyclopropane would be blamed if, let us say, the patient died. That is one reason why I am reluctant to give cyclopropane to a patient with cardiac disease. Ether would be contraindicated because it would intensify the shock state. I think the best bet would be local anesthesia, and if a sedative were given, the preference would be pentothal sodium.

DR. MCNEAL: I have nothing to add to Dr. Adriani's selection. I entirely agree with it.

I take for granted from the description of the condition of the patient on arrival at the hospital and in the operating room that some effort had been made to correct dehydration and to improve the fluid balance. I think every effort should be made to do so in the time between admittance and the operation, if the patient is to survive the operation even with local or field block anesthesia.

Miss Lamb: I would add that a patient in this condition would probably have some fluid in his stomach, and I would certainly introduce a stomach tube.

Do you approve of the intravenous administration of nembutal for basal anesthesia or for induction of anesthesia?

Dr. Adriani: We have been doing some work with the administration of seconal and comparing the results with those of the administration of nembutal. Nembutal and seconal are short-acting drugs used principally for hypnosis. It takes longer to produce hypnosis with either of these drugs than it does with pentothal sodium, but the depth of hypnosis is less.

There isn't much difference between the effects of seconal and those of nembutal administered intravenously. It takes three or four minutes to obtain a complete basal narcosis with 150 mg. seconal given intravenously. The same effect is produced in ten to fifteen minutes when nembutal is used. Either seconal or nembutal is suitable for a patient who is extremely apprehensive.

All of these barbiturates affect respiration, and sometimes a patient receiving such medication has difficulty in breathing. Sometimes the preliminary use of these drugs is unnecessary and undesired, because patients respond in different ways to them.

The dosage is usually fixed. We found that a dose in excess of 150 mg. depresses respiration, and usually the blood pressure decreases, too.

Will an intravenous drip of procaine control an increased pulse rate and arrhythmia? What percentage is recommended?

Dr. McNeal: It has been suggested that a 0.1 per cent solution of procaine given before or during an operation will help to prevent the occurrence of arrhythmia. My experience with the use of a 0.1 per cent solution has been discouraging. There have been some reports on the use of a 1 per cent solution administered as a continuous drip, the rate being speeded up or slowed down as necessary to decrease arrhythmia.

Burstein recommended having between 5 and 10 cc. of a 1 per cent solution of procaine in a syringe ready to inject directly and fairly rapidly on the appearance of arrhythmia. My experience in using it to decrease the pulse rate has not been uniformly successful. For the control of arrhythmia, particularly arrhythmia of ventricular origin, the results have been excellent. However, so far as agreeing with Burstein that procaine is the magic drug—the implication being that it will prevent arrhythmia throughout the rest of the procedure—I have not had that experience. I have had arrhythmias disappear and the heart rate return to normal for ten or fifteen minutes; then the arrhythmia would recur, on the basis that procaine is broken down in between twenty minutes and half an hour.

I don't know whether it would be appropriate to mention a little experience I have had with pronestyl. I have used it to some extent,

but in smaller dosages than those recommended by some authorities. I use from 100 to 200 mg., and the results seem to be as good as those obtained with procaine, with a slight prolongation of the effect.

At a meeting in Houston one physician pointed out that he could actually see additional electrocardiographic irregularities with the use of procaine. However, in the discussion a physician from New York pointed out that the dose was large and that the drug was given too rapidly, and that even were the heart normal the dosage would produce an abnormal cardiac record as a result of the toxic effect.

What percentage of helium or carbon dioxide in the anesthetic mixture is adequate as a "quenching agent" in an explosive mixture? Is helium of any value when given with oxygen to a patient before he leaves the operating room?

DR. ADRIANI: Before I answer that question, I would like to say that I agree with Dr. McNeal with respect to procaine and pronestyl. We have a direct writing electrocardiograph, which we bring into the operating room whenever we need it. It is remarkable to note how arrhythmias persist in spite of the intravenous administration of procaine or pronestyl.

Thomas has written a good deal about the question of what percentage of helium or carbon dioxide in a mixture would be considered adequate as a "quenching agent." I do know that a mixture of 25 per cent cyclopropane, 25 per cent helium, and 50 per cent oxygen is supposed to be noninflammable. It has been shown by the Bureau of Mines that about 5 per cent carbon dioxide is needed in an anesthetic mixture to make it noninflammable. However, that 5 per cent isn't compatible with decent or satisfactory anesthesia.

DR. MCNEAL: The question I have been asked is whether helium mixed with oxygen and administered at the termination of anesthesia has any value. I have been accustomed to administer helium with oxygen at the termination of cyclopropane anesthesia. All of us have observed the sudden decrease in blood pressure at the end of an uneventful cyclopropane anesthesia. A number of explanations have been offered to account for this decrease, and a number of methods have been suggested to prevent it. One explanation is that the decrease in blood pressure is a result of the decrease in the oxygen content of the inspired air when the patient is permitted to breathe the room atmosphere. Another is that the respirations are very shallow throughout cyclopropane anesthesia and carbon dioxide accumulates. The condition really should not be called cyclopropane shock but carbon dioxide shock, for the blood pressure has been supported by the accumulation of carbon dioxide, and as the carbon dioxide is eliminated, the blood pressure decreases. Furthermore, as a result of the shallow respiration the alveoli tend to stick together and be poorly ventilated.

The purpose of administering helium with oxygen is to produce hyperventilation in the pre-awakening period, so that the oxygen left behind in the lungs will not be quite so readily absorbed. The object

is to leave some helium in the lungs after hyperventilation so that the alveoli will definitely open. I think this can be equally well accomplished if nitrogen instead of helium is used. If nitrogen is not available in tanks, the type of bag that can be blown into from the other end may be used. This probably would be equally effective and certainly less expensive. It seems to me that if the administration of cyclopropane could be discontinued and nitrous oxide and oxygen given early by calculating the time the operation should end, and then hyperventilation produced by the use of helium and oxygen, there would be less tendency for the blood pressure to decrease.

During a long operation a patient goes into shock, and blood is given, although apparently he is not losing too much blood. After 2,000 cc. blood is given, the operation is still not completed. Would you give still more blood? Is there danger of overloading the circulatory system with blood?

DR. ROBINSON: Certainly, one of the most pertinent features of this question has to do with the amount of blood that has been lost. I know that on occasion I have been prone to underestimate the amount of blood that has been lost during an operation. During recent years some excellent studies have been made of this problem, and we have come to find out that usually more blood is lost than we realize.

For example, each of us at one time or another has been asked by the surgeon to give a patient a whiff of gas or a drop of pentothal sodium. That may mean anything from a five minute anesthesia to a one hour anesthesia is required. The same is true of blood loss. The patient usually loses more than anyone realizes.

It has been definitely shown that even under the best conditions a patient undergoing gastric resection will lose a minimum of 1,300 cc. blood. So even though a patient has received 2,000 cc. blood, I would continue to give additional blood.

To me, a workable definition of shock is a reduction in the volume of effectively circulating blood. Of course, there are causes of shock other than blood loss. However, I am assuming that in this particular case it was a major operation, and I would certainly continue to give blood.

There is a definite danger, however, of giving too much blood, particularly to an elderly patient. In other words, if the circulatory system is overloaded, there will be a tendency towards pulmonary edema, which is certainly undesirable.

Discuss preoperative sedation and dosages for children under 10 years of age.

DR. ROBINSON: One thing that I am more or less adamant about in my department is that a child is never given premedication by mouth. I prefer to give premedication parenterally or by rectum.

MISS LAMB: What drugs do you use, Dr. Robinson?

DR. ROBINSON: I use one of the barbiturates and atropine.

MISS LAMB: I think premedication for children is a great question.

In reading the literature on the subject one finds a great variation in the dosages and the drugs recommended.

I prefer not to give any patient atropine, because I think it predisposes to a disturbance of the heat-regulating mechanism with an elevation of temperature. I think that if a child is given ether in low concentration, there will not be excessive secretion of mucus. So I prefer not to give premedication to children under 10 years of age, unless it is a barbiturate given the night before or in the morning two or three hours before operation.

DR. BRUHN: I have only one comment to make, and that is concerning the action of atropine administered hypodermically. We all know that atropine blocks sympathetic nerves.

The sweat glands are polyptychial glands, and they respond to the action of atropine rather than to that of adrenalin. For that reason atropine will block the action of the nerves on the sweat glands, and therefore one mechanism for controlling heat is lost to the body.

MISS BOGGAN: I agree. I do not care for atropine, and I do like barbiturates administered rectally for a child under 10 years of age.

DR. MCNEAL: This has been a much argued question, and I am sure that we increase the risk by giving premedication to children. There has been so much written about psychic shock and the effect on a child of the traumatic experiences of an operation that I think the slight added risk of premedication is being more and more disregarded.

DR. ADRIANI: I am for atropine. I do a good deal of lecturing to postgraduate groups, and I think of all the questions that are asked this comes up the most frequently. Some rule of thumb for giving premedication to children is wanted, and there isn't any.

When I became director of the anesthesia department at Charity Hospital, I prepared a mimeographed table of dosages of morphine and atropine for the benefit of the intern or whoever was to give premedication. On a number of occasions I have seen 18 month old babies given morphine, gr. 1/6. So we have abolished the table, and unless we can see the patients ourselves, we prefer to have them come to the operating room without anything and to administer the premedication intravenously in the operating room.

Certain types of patients, however, require special handling. For instance, when cardiac catheterization is scheduled, we don't want the patient to get unduly excited about the catheter. In such a case we give premedication either rectally or orally.

There are very few cases in which a single dose of atropine causes serious hyperthermia that could have been prevented. I have seen some instances in which too much atropine has been given, and that is why we prefer to give such medication ourselves. Most cases of hyperthermia from atropine that I have seen have been due to the continued administration of belladonna alkaloids or drops of atropine and partic-

ularly to children who have had clonic spasm.

I believe very strongly that atropine is indicated, and we won't administer anesthesia without it.

Why are a patient's reflexes more active in the presence of hypoxia?

DR. BRUHN: The answer to this question depends on an understanding of the effect of the facilitory action of the brain stem and inhibitory action of the cerebral cortex. The cerebral cortex is more sensitive to deprivation of oxygen than almost any other part of the brain. Since it is more sensitive to deprivation of oxygen, any inhibitory reflex arising from the cerebral cortex will not take place, and the facilitory reflex, located in the brain stem, will dominate. Therefore, all reflexes will be exaggerated.

What type of anesthesia is recommended for a patient who has slight pulmonary edema? Is it possible to produce pulmonary edema by giving 500 cc. whole blood during cholecystectomy plus 200 cc. of other fluids to a patient who has a normal nonprotein nitrogen level?

DR. ADRIANI: I shall answer these questions together, since they are related.

Slight pulmonary edema: I think the term needs a little elaboration. As you do not have a slight coronary occlusion, you either have pulmonary edema, or you don't. Pulmonary edema is a serious condition. There is no degree to it. If you have pulmonary edema, something serious is going on.

Pulmonary edema occasionally occurs during anesthesia, and it has a varied origin. In most instances it is due to cardiac disease. Pulmonary edema will develop in a patient with cardiac disease, and anything that is done to create anoxia or obstruct the airway or interfere with the action of the heart will precipitate or accentuate it.

I remember quite vividly a boy in whom the only abnormal physical finding was a presystolic murmur, which had been missed by the referring physician who had examined the boy. It is not hard to miss a presystolic murmur. When this boy was put in the Trendelenburg position, pulmonary edema developed. We leveled the table and gave him oxygen and applied tourniquets, and the pulmonary edema cleared up. When the cardiologist saw him, he found a mitral stenosis, which is a very serious condition. Pulmonary edema is a serious thing, and often a patient drowns in his own secretions. Cardiac disease is one cause. Another is the administration of too much fluid. It will precipitate pulmonary edema. I have seen it happen during thoracic operations. About a year ago at Charity Hospital saline solution was administered to a little boy, pulmonary edema developed, and he died of asphyxia. The condition could not be brought under control.

As little as 100 cc. blood can produce pulmonary edema in a patient on the verge of cardiac failure. Many patients have been drowned with saline solution. When I was a house surgeon, I used to give 8 and 9 L. saline in a day, and I know of three or four cases in which

saline solution was given, and the patient was drowned. Not nearly so much saline solution is used today.

The third cause of pulmonary edema is the presence of some chemical, some impurity, in such an agent as nitric oxide. In this case the onset would be delayed. The pulmonary edema would not develop immediately after the inhalation of the noxious substance but after some time, and a chemical edema, due to the formation of nitric acid and nitrous acid, would result.

The fourth cause of pulmonary edema is an obstructed airway, with transudation of fluid through the capillaries. A patient who receives an overdose of a barbiturate will sleep a long time, and obstruction to inspiration, particularly in combination with anoxia, will produce pulmonary edema.

In the last few years we have had cases of what I call idiopathic pulmonary edema: pulmonary edema for no reason at all. The condition of the heart was good, and we were satisfied that the anesthetic was given in the proper manner, yet pulmonary edema developed.

In the past surgeons caused pulmonary edema by treatment in their operations. I think one of the causes was the use of drop ether. Also not so much was known about the importance of a patent airway or the significance of anoxia as is known today. Suction was also unheard of in the old time operating room.

When pulmonary edema develops, all the anesthetist can do is to increase the oxygen pressure, although this has no value when the alveoli are damaged in some way.

Our anesthetics, so far as we know, cause no damage to the alveoli. Necropsy of a lung from a patient who dies during an operation under ether anesthesia shows no damage to the alveoli, unless there were impurities in the ether.

MISS LAMB: May I ask a question of you, Dr. Adriani. You mentioned the patient in whom pulmonary edema developed when he was placed in the Trendelenburg position, and you do not recommend that that position be used in all cases because of the possibility of undiscovered cardiac disease. Originally, the Trendelenburg position was used to facilitate operation, when anesthetists were not so skilled as they are today. I would never request that a patient be put in the Trendelenburg position when he is in shock, because of the strain of the position and because the weight against the diaphragm, the lungs, and the heart increases the difficulties of respiration. The idea that circulation in the upper part of the body is increased by gravity when the Trendelenburg position is used is sort of farfetched; the blood will have to flow down, because what goes up has to come down. I would like to have your opinion on this matter.

DR. ADRIANI: I never personally put a patient in shock in the Trendelenburg position because it does very little good. There have been cases in which the table has been tilted, and for no reason at all sudden inexplicable changes have occurred, such as a decrease in

blood pressure or an increase in pulse rate. When the table was made level, the blood pressure would immediately increase. Probably a decrease in ventilation is one of the factors. About the only time I ask for the Trendelenburg position is when I am worried about drainage from the stomach or danger of aspiration. Otherwise, I try to persuade the surgeon to do the operation with the patient flat on his back, even for thoracic operations.

What causes nausea and vomiting after the administration of spinal anesthesia?

DR. MCNEAL: That question is a little ambiguous. If the complaint is in the postoperative period, the causes are probably unrelated to the spinal anesthesia. I am sure most of us have suffered disappointment when a patient has vomited in the postoperative period and we have not given him anything that would make him vomit, the vomiting being caused by traumatic handling on the way to the ward and the narcotic agents used. However, I take it that this question refers to the occurrence of nausea and vomiting after the administration of spinal anesthesia while the agent is still effective.

The first and commonest cause for the immediate appearance of nausea and vomiting after spinal anesthesia is administered is anoxia as a result of the decrease in blood pressure that occurs within five or ten minutes after a spinal anesthetic is given. Frequently, the blood pressure is not being carefully watched. The first indication of a decrease in blood pressure is that the patient suddenly becomes nauseated and begins vomiting and is sick. Vasopressor drugs are indicated and oxygen by inhalation.

However, particularly during an abdominal operation—for example, during a difficult appendectomy—nausea and vomiting may occur without a decrease in blood pressure. There are several theories to explain this phenomenon. One is that it is due to sympathetic nervous system reflexes in nerves that enter the spinal cord above the upper level of the anesthesia. The other is that vagal reflexes are stimulated, and you'd better not have them blocked. Consequently, nausea and vomiting may occur well into the course of an operation and usually are related to traction, particularly in the upper abdomen. Under such circumstances the only answer is to supplement the anesthesia with some form of general anesthesia.

Do you advise lubricating intratracheal tubes? If so, what is the best lubricant?

DR. ROBINSON: I realize that there is a difference of opinion on this particular point. I believe that most complications in intratracheal anesthesia result from difficult intubation, from roughness in introducing the tube. I prefer always to lubricate intratracheal tubes mainly to facilitate their introduction. I think doing anything that will make the tube less traumatic and easier to introduce is desirable.

I would like to say a word of caution about lubricating tubes. You should be sure not to get a large quantity of the lubricant in the

lumen of the tube, lest you inadvertently introduce a tube that is blocked off with the lubricating substance. I don't think it makes too much difference what type of lubricant is used.

Does cyclopropane cause an increase in bleeding during an operation?

DR. ADRIANI: I think we have all heard the answer to this question from the surgeons. They will always tell you that cyclopropane causes an increase in bleeding.

The bleeding time or clotting time is not altered by cyclopropane and, for that matter, is not significantly altered by any anesthetic drug. The apparent increase in bleeding is probably due to dilatation of the blood vessels and other conditions. A patient who has an increase in blood pressure will always seem to bleed more when the vessels are cut. The increase in blood pressure makes it obvious that there is more bleeding; without an increase in blood pressure, I am not always convinced that there is more bleeding. The same thing may happen when agents other than cyclopropane are used, and I have often seen it occur with the use of ethylene and ether.

During cyclopropane anesthesia the arterial oxygen content is practically unchanged. In the arteries oxyhemoglobin is in its normal concentration during cyclopropane anesthesia, but the venous blood oxygen is increased. The impression is thus gained that cyclopropane permits the administration of more oxygen. The fact that the venous blood is pinker does not mean that the patient is getting more oxygen. He may be getting less, or he may be using less, or it may be going through the vessels more rapidly.

Discuss the problem of an emergency operation on a patient with a full stomach.

DR. ADRIANI: A patient with a full stomach is a poor surgical risk, and there are very few times when an operation needs to be performed on a patient with a full stomach. Factors other than the patient's needs may be involved in the scheduling of an operation. The surgeon may have to be home at six o'clock for dinner with his wife, or he may have to keep office hours and would like to get the operation done. A resident or a young doctor may say that he has to put a cast on a child who has had something to eat. He can't wait because he has to attend clinics, and tomorrow morning he has something else he wants to do. He doesn't want to put it off, because at his convenience it can't be put off. He thus insists on anesthesia for his own convenience.

If a patient with a full stomach doesn't vomit during induction, he is going to afterwards; there are very few patients with full stomachs who don't vomit. So the best thing to do is to postpone the operation. If the operation really needs to be done, the anesthetist must be prepared to use suction and to tilt the operating table. The table should be one that can be tilted; when an operation is performed on a table that can't be tilted, one is asking for trouble.

Some may recommend washing out the patient's stomach. I have

washed out many a stomach, and I know I have put in two quarts of water and have got only one quart back. So the situation is not improved by trying to wash out the patient's stomach. Several years ago this problem came up with respect to a soldier who was to undergo an operation just after he had eaten, and it was suggested that a big stomach tube be used. I said, "You are not going to put water in there, are you?" And I was told, "No, I am putting it in there to make him vomit." This might be done to a soldier who has to take orders, but I doubt if it could be done to a private patient.

In a normal person the stomach will empty in a matter of four or five hours. However, if a person is under tension or is apprehensive, the stomach won't empty. I recall a rather nervous resident I anesthetized eight or nine years ago. He ate breakfast in the morning, and at six o'clock in the evening all the food from his breakfast was still undigested in his stomach. Consequently, one should not be fooled into believing that the stomach will empty itself within a few hours.

My feeling is that if the patient has a full stomach, the operation should be deferred if that is at all possible. If it can't be deferred, the possibility of asphyxia from aspiration is ever present, regardless of whether general or intravenous or local or spinal anesthesia is administered.

MISS LAMB: What can be done for obstetric patients? For them the procedure cannot be deferred.

DR. ADRIANI: That is right, and the obstetric patient is the one who really worries me. But all the anesthetist can do is to have the suction apparatus ready and be prepared to tilt the table. Obstetricians might also be impressed with the inadvisability of allowing patients approaching delivery to eat. Some of them say, "I let my patients eat right up to the time of delivery."

Do you advocate the inhalation of a carbon dioxide-oxygen mixture for the prevention of atelectasis during the postoperative period? If so, what percentages should be used?

MISS LAMB: There is rather general agreement that the inhalation of carbon dioxide will not help prevent atelectasis. The reason given for administering carbon dioxide is that it increases the volume of respiration and consequently the pulmonary ventilation. However, it is so frequently given improperly that in most instances it isn't effective. By stimulating reflex activity, encouraging coughing, and turning the patient the incidence of postoperative complications is more likely to be reduced than by the improper administration of carbon dioxide.

If carbon dioxide is given, the concentration to be used would depend upon the method of administration. If it is given with a tube and a funnel, the concentration should not be higher than 10 per cent.

What is the anesthesia of choice for pneumoencephalography for children?

DR. ADRIANI: The choice of anesthesia for pneumoencephalography

for children is always a problem. I believe that pneumoencephalography, whether for adults or children, is a procedure that is attended by hazards, the mortality rate being 3 or 4 per cent. If the anesthesia department has anything to do with the procedure, I insist that it be done in the operating room. A basal anesthesia with seconal given rectally or with pentothal sodium plus maintenance with ether and oxygen proves satisfactory.

What is the anesthesia of choice for children undergoing operations on the eye?

DR. ADRIANI: During operations on the eye there is always the problem of maintaining a patent airway, and the choice of anesthetic is cyclopropane or ether administered intratracheally. The idea is to use an intratracheal tube. The agent itself makes little difference, so far as I am concerned. If the anesthetist is not too experienced, I would recommend ether, but for an experienced anesthetist I would recommend cyclopropane. I don't agree that cyclopropane is contraindicated for children. I have given it to newborns and to patients all the way up to 100 years of age.

What is the anesthesia of choice when the Smith-Peterson procedure is performed for fracture of the femur in an old person?

DR. ADRIANI: Despite the fact that these patients are in the older age group, 75 to 80 years of age, they have very few untoward reactions. If the patient is a poor risk, with cardiac disease, for example, as much of the operation should be performed under local anesthesia as possible, perhaps with the addition of a small amount of pentothal sodium. The use of ether is not satisfactory, because the patient will sleep a long time afterwards. A new local anesthetic agent called xylocaine has the advantage of diffusing well into the tissues, and the amount of general anesthesia that is needed when this agent is used is less than when procaine is used.

Is syncurine as good a muscle relaxant as *d*-tubocurarine chloride?

DR. ROBINSON: I have been using syncurine for about a year, and I can see no difference between the muscular relaxation it provides and that produced by *d*-tubocurarine chloride. However, milligram for milligram, syncurine is a much more potent relaxant than *d*-tubocurarine chloride, and as yet there is no specific antidote for it as there is for *d*-tubocurarine chloride. One of the principal things I have noted about syncurine is the intensity of its effect, which is unpredictable from one patient to another.

Does curare cause dilatation of the stomach, and, if so, how?

DR. ADRIANI: It is generally agreed that curare has no noticeable effect on smooth muscle. Most of its effect is on striated muscle. Ordinarily, during an operation one sees very little effect on the intestines or on the stomach. Cullen and Gross found that by using doses larger than are usually used during anesthesia they could produce some dilatation of the bowel and the stomach, and they believed the effect to be due to the action of curare on the autonomic nervous

system. However, I don't think that one need worry that curare will cause any significant dilatation of either the intestine or the stomach.

What is the cause of laryngospasm during pentothal sodium anesthesia, and how can it be prevented? What is the recommended treatment?

DR. ADRIANI: Laryngospasm during pentothal sodium anesthesia has been ascribed to the supposed effect of pentothal sodium on the vagus nerve, and for years we have been recommending that atropine be given as a prophylactic measure. However, I have seen laryngospasm occur when the patient has received as much as atropine, gr. 1/100. I have also seen patients with incomplete laryngospasm who were given more atropine, and nothing happened. So, I am inclined to doubt that pentothal sodium acts on the vagus nerve.

However, we do know this: The barbiturates do not suppress the cough reflex, and in some cases they enhance it. For example, a tracheotomy may be done under local anesthesia until the tube is slipped in and then pentothal sodium given. Now, when the tracheotomy tube is slipped in, the patient may cough a little bit but will tolerate the tube. But as soon as pentothal sodium is administered, he will begin to cough violently and may have severe laryngospasm.

I think it is more logical to use curare for the prevention or relief of laryngospasm, because curare acts at the nerve endings of striated muscle, and the muscles of the vocal cords are striated.

Laryngospasm during cyclopropane anesthesia is said to be due to the parasympathetic action of cyclopropane, but here again we have no proof. There is some evidence that cyclopropane has certain physiologic effects that are indicative of parasympathetic stimulation, but actual proof is lacking, and more work should be done on it.

Please discuss bronchiospasm, its cause and treatment.

DR. ADRIANI: Cyclopropane and pentothal sodium may also contribute to the production of bronchiospasm. I have seen a patient have an attack of bronchiospasm during cyclopropane anesthesia that sounded as though he had asthma. The patient had no history of asthma, and the wheezing disappeared when the agent was changed to ether. I have also seen severe bronchiospasm during pentothal sodium anesthesia.

It seems to me that most patients who have bronchiospasm have exudate in their lungs, for example, patients with tuberculosis or bronchiectasis or lung abscess. Consequently, pentothal sodium is not a good agent for this type of patient.

As to the treatment of bronchiospasm, all one can do is to try to inflate the lungs under positive pressure and to administer bronchodilators.

The patient with asthma seems prone to have bronchiospasm and laryngospasm regardless of the agent used, because the tendency toward spasm is enhanced in the asthmatic patient. Generally speaking, it is best not to give cyclopropane or pentothal sodium to a pa-

tient with asthma. Ether has a bronchodilating action and is the agent of choice. I have seen a patient have an attack of asthma during induction of anesthesia and the disappearance of the symptoms as soon as positive pressure was used to inflate the lungs and ether administered.

What type of anesthesia should be used for a patient with pulmonary edema?

DR. ADRIANI: The answer depends on the cause of the pulmonary edema. Most patients with pulmonary edema have cardiac disease. For a patient with pulmonary edema or congestion, ether should be used if general anesthesia is needed. If the use of ether is contraindicated, a combination of an abdominal field block anesthesia and ethylene may be used. While some surgeons want to use spinal anesthesia, I believe that spinal anesthesia is definitely contraindicated for a patient with cardiac disease. If the patient has impending cardiac failure and must undergo an operation and if his condition is so serious that no form of general anesthesia is desirable, local anesthesia combined with a sedative would be acceptable.

Please discuss the prevention and treatment of headache occurring after spinal anesthesia.

DR. ROBINSON: According to the literature, there are about as many methods of treating headache occurring after spinal anesthesia as there are technics for administering the anesthesia. Among the measures advocated are caffeine sodiobenzoate, empirin, the administration of glucose, the intravenous administration of nicotinic acid, the intrathecal injection of fluids, and keeping the patient quiet in a dark room. I think most authorities agree that headache after spinal anesthesia is caused by a leakage of spinal fluid from the subarachnoid space at the site of lumbar puncture. I have found that a mild sedative along with empirin works about as well as anything. Also, once a patient has a headache after spinal anesthesia, one should not try to raise him to the upright position all at once, but gradually.

Discuss anesthesia for cesarean section in the presence of fetal distress.

DR. MCNEAL: I believe that in most clinics spinal anesthesia is the method of choice for cesarean section except in the presence of hemorrhage. If the mother is not given an agent that causes depression, the baby will breathe immediately upon delivery. Consequently, spinal anesthesia is preferred, provided the blood pressure is not allowed to decrease. If the blood pressure decreases to an alarming level, the effect is the same on the fetus as if general anesthesia were given with an oxygen concentration less than that of atmospheric air.

Local anesthesia might be used, but in the presence of fetal distress there is the problem of delivering the baby as rapidly as possible.

Discuss the occurrence of convulsive tremors during and after anesthesia.

MISS LAMB: There are different types of convulsions. There are

so-called ether convulsions, the convulsions that are seen early during anesthesia, and those that sometimes result in a fatality.

The ether tremor, which is sometimes seen early during anesthesia, is due to stimulation within the brain, and it can be corrected by deepening the anesthesia.

The other types of convulsive seizures are anoxic in character. Early manifestations of oxygen want are piano-playing movements of the fingers and rhythmic movements of the feet. These movements may be misinterpreted as being due to lack of depth of anesthesia, and instead of the patient's being given more oxygen, the anesthesia may be deepened. If the oxygen supply continues to be limited, signs of great deprivation of oxygen will be manifested, such as clonic spasm. Cyanosis sometimes, but not always, accompanies the convulsive seizure; if the hemoglobin content of the blood is less than 5 mg. per 100 cc., cyanosis will not be evident despite the presence of suboxygenation.

As to the convulsive tremors that develop during anesthesia and continue postoperatively and often result in death, there are at least fifty or more stated causes. Among other things, they have been said to be due to the administration of ether, to an excess of carbon dioxide, and to the technic of administration.

This progressive type of convulsive seizure actually begins with the administration of premedication. A very early symptom is an elevation of temperature, and we routinely take the temperature of all patients before anesthesia is administered. I know of children who have been given atropine and who have had a normal temperature at the eight o'clock reading and a temperature of 102 F. or 103 F. at the time anesthesia was to be administered. The same thing has occurred in patients who have received morphine. We cancelled a few of those cases, and when the premedication with atropine or morphine was eliminated, the patients had an uneventful anesthesia.

After a slight elevation of temperature of one half or one degree, there will be an elevation of blood pressure within about a half hour, which could be misinterpreted as being due to light anesthesia or anoxemia. A tugging, not jerking, type of respiration will occur that will not be noticed by watching the rebreathing bag but that can be definitely felt if the anesthetist has a hand on the patient's chin. If corrective measures are not taken by this time, the convulsive seizure will begin on the left side, around the left side of the mouth and the left eye, and progress to the left arm and eventually become generalized.

To prevent this type of convulsive seizure the temperature should be taken before anesthesia is administered, and if it is elevated, an ice bag should be put under the nape of the patient's neck as soon as he is asleep and fluids administered intravenously, usually 5 per cent glucose in water. The treatment of a generalized seizure consists of the administration of pentothal sodium. However, by being alert to the characteristic signs of an impending convulsion, I believe it may

be prevented.

Discuss the use of pentothal sodium for children under 10 years of age, its use as the sole anesthetic agent with curare, and its use with procaine.

DR. ADRIANI: To set 10 years of age as a limit below which pentothal sodium should not be given is not correct, although it is not advisable to give it to younger children because it does cause depression. Sometimes a child requires a large amount of pentothal sodium to put him to sleep, and then he slumbers for a long time afterwards. In some cases it is advantageous to use it. However, if it is given as a basal anesthetic, it should not be used as the anesthetic for the operation. Pentothal sodium given rectally to a child in bed relieves him of that psychic fear that pediatricians tell us will make the patient a psychiatric wreck in later years. I don't like to give pentothal sodium intravenously to children under 10 years of age for one reason: When a child sees you coming at him with a needle, he is not the most co-operative patient in the world.

It is true that pentothal sodium is not a true anesthetic. Barbiturates are not anesthetics; they are hypnotics. In order to establish anesthesia, that is, to abolish reflex activity, an amount large enough to depress the medulla must be used.

Pentothal sodium is stored in the fatty tissues of the body and is destroyed in the liver. Consequently, to give pentothal sodium to a patient with liver damage is not wise. Although a single test of liver function does not prove that the liver is damaged, in the presence of proved liver disease, pentothal sodium is contraindicated. We know that the rate of metabolism is slowed in an old patient and that the destruction of pentothal sodium is not so rapid as it is in a young patient. There is also a day-to-day variation in a patient's tolerance for the drug. In addition, when pentothal sodium is given as the sole anesthetic agent, which requires large amounts, the effect is cumulative, and this prolongs the depression.

It is not wise to give pentothal sodium alone. Neither pentothal sodium nor nitrous oxide provides the necessary relaxation, and that relaxation is obtained by the adjunctive use of curare or a similar drug. Such a combination, if used with intelligence and discretion, is certainly all right. However, if you have to give 2 or 3 Gm. pentothal sodium in fifteen or twenty minutes with nothing else save oxygen, you are going to get into trouble.

My experience with the use of a combination of pentothal sodium and procaine has not been satisfactory, for I have found that patients given the combination have a tendency to sleep twice as long as one would ordinarily expect them to.

What is the choice of anesthesia for a patient with myasthenia gravis?

DR. ADRIANI: I have had the opportunity of putting two or three patients with myasthenia gravis to sleep, and in each case I have used

cyclopropane. In general I think cyclopropane is the agent of choice. Ether has more of a curare-like action than cyclopropane, and cyclopropane does not seem to cause the depression that ether does.

Is ether contraindicated for a patient with chronic nephritis?

DR. BRUHN: If ether damages the tubular cells, and it probably does, it would be contraindicated for a patient with chronic nephritis. There are several factors involved. First, and probably most important, is the maintenance of the acid-base balance after ether anesthesia, the maintenance of the acid-base balance being a function of the tubular cells. Consequently, if the damage to the tubular cells is increased by the administration of ether, the kidney would probably have a difficult time in maintaining the acid-base balance.

Please discuss the Hering-Breuer reflex with respect to respiration.

DR. BRUHN: The Hering-Breuer reflex has two phases. The first is the reflex initiated at the end of inspiration, that is, as the stretch receptors in the lungs are stimulated. Impulses travel over the vagus to the medulla, where they establish connection with the respiratory center to inhibit inspiration and permit passive expiration to take place.

The other phase of the Hering-Breuer reflex operates at the end of expiration. When the chest is relaxed and the lungs are approaching collapse, the receptors are again stimulated, and impulses travel to the respiratory center to cause inspiration to start sooner than it would otherwise.

This mechanism, on the one hand, inhibits inspiration and, on the other, stimulates inspiration so that the respiratory rate can be increased.

Should epinephrine be used in the treatment of shock?

DR. ADRIANI: It is generally agreed that the use of vasoconstrictors is dangerous in the presence of shock. Shock should be treated by the administration of fluids, particularly blood. Occasionally, shock may be due to no organic origin and may be treated with vasoconstrictors provided fluid is also given. Again, if an adequate amount of blood has been given without response, small doses of vasoconstrictors may help. But a vasoconstrictor should never be used to treat shock per se.

How can acidosis be controlled during anesthesia?

DR. ADRIANI: It is most important to know what causes the acidosis. The two commonest causes are renal shut-down and diabetes. Occasionally, a dehydrated patient will have acidosis. The object is not to increase the acidosis, by allowing carbon dioxide to accumulate, or the formation of the acid product such as lactic acid, which would form during anoxia. Consequently, if a patient has acidosis during anesthesia it is advisable to eliminate rebreathing and to use an anesthetic that will not increase the acidosis. That means that anoxia must be prevented. Ether increases acidosis and would not be so desirable an agent as cyclopropane. Local anesthesia could be used. A patient with acidosis is usually in a serious condition, and it would be advisable not to use spinal anesthesia.

NOTES

CASE REPORTS are the foundation of the medical literature. Their brevity makes them interesting to write and assures their being read. There is a place in this section of NOTES for case reports as well as for descriptions of gadgets and special technics. Send in your contribubtion now. Other anesthetists will be helped by it.

USE OF SERUM ALBUMIN FOR RELIEF OF CEREBRAL EDEMA.—A woman, aged 53, was admitted to the hospital for evaluation of her hypertension and for treatment of severe constant pain in her left shoulder and hand from prolonged cardiovascular strain by stellate ganglion block. Her blood pressure was recorded as being 300 mm. Hg systolic and 140 mm. Hg diastolic by her attending physician. The left stellate ganglion was successfully blocked with novocain and Horner's syndrome produced. Definite relief of pain in the left shoulder and arm was effected. The right stellate ganglion was blocked the following day with 8 cc. of 2 per cent novocain. Following the procedure apnea developed as a result of the accidental infiltration of novocain into the spinal canal. She was given artificial respiration manually until oxygen could be administered by a gas machine. A precipitous decrease in blood pressure also occurred: the pressure could not be measured, and the heart sounds were inaudible for several minutes.

Analeptics, including epinephrine, neosynephrin, caffeine, and sodium benzoate, were administered, and 500 cc. of plasma was given intravenously. Oxygen was also given through an intratracheal tube without effect. After about fifteen minutes 10 cc. of calcium chloride in 5 per cent solution was given intravenously. The pulse immediately became regular and forceful again, and the blood pressure increased to 170 mm. Hg systolic and 100 mm. Hg diastolic. Spontaneous respiration was resumed about forty-five minutes later.

In spite of this improvement the patient had definite signs of cerebral edema. I suggested trying serum albumin as recommended by Lundy,[1] and 100 cc. of serum albumin was given one and a half hours later with slight improvement. Facial grimacing and twitching continued, however. Another 100 cc. was administered four hours later with more improvement. The patient was able to repeat sentences and responded to commands. The last dose of serum albumin was given four hours later. The signs of cerebral edema subsided, and the patient had an uneventful recovery. The progressive improvement following the administration of serum albumin was very definite.

(Continued on page 242)

1. Lundy, J. S.; Waugh, John, and Adams, R. C.: Balanced anesthesia and supportive therapy. J. Am. A. Nurse Anesthetists **18**:174-193, Aug. 1950.

LEGISLATION

Emanuel L. Hayt, LL.B.*

HOSPITAL AND NURSES MUST EXPLAIN CAUSE OF INJURIES TO UNCONSCIOUS PATIENT.[1]—The patient's physician arranged for her admission to the hospital. He examined her upon arrival but saw no burns upon her body. He did not direct that heat be applied to the patient, nor did he know what caused the burns. The attending nurse had no idea how the patient became injured. However, the fact remained that the patient, while unconscious and in a diabetic coma, complicated by pneumonia, suffered these injuries.

The court held there was abundant proof that the patient was injured while in the hospital. The persons within the hospital charged with her care, protection, and treatment were in absolute control of the situation. She did not know and could not have known what apparatus was used in injuring her. These circumstances, said the court, justify an inference that, while the patient was unconscious in the hospital, she was burned by some instrumentality that was negligently used or that should not have been used at all. The legal doctrine of res ipsa loquitur ("the thing speaks for itself") was properly invoked, and the jury was justified in fixing the responsibility on the hospital, although there was no direct proof of negligence. It was for the hospital to give a reasonable explanation of how the patient was injured, but it failed to do so.

STATE HELD NOT LIABLE FOR DEATH CAUSED BY PLASMA ADMINISTRATION.[2]—It has been held that the State of New York, acting as a distributor of pooled blood plasma, was not liable to the estate of a patient who had contracted homologous serum jaundice through transfusion of pooled blood plasma, which had been ordered by the attending physician.

The patient had been admitted to a voluntary hospital after having been picked up unconscious on the road. The resident physician prescribed shock therapy and a transfusion of pooled blood plasma. A week later the patient left the hospital and returned to his employment after a period of convalescence. Three months later he was readmitted to the hospital suffering from homologous serum jaundice, or hepatitis, and died eleven days thereafter. His death resulted from the fact that the plasma had been infected with the jaundice virus.

The plasma was war surplus blood plasma, which had been originally procured for the Army and Navy by the American Red Cross. The particular plasma administered to the patient had been shipped to the local branch

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1. West Coast Hospital Association v. Webb, 19 CCH Neg. Cases, 695 (Fla.).

2. Parker v. State of New York, 105 N.Y.S. 2d 735.

of the Red Cross, which stored the material and delivered it untouched and in its original package to the hospital, in response to a request communicated to the County Health Commissioner, who had been designated by the State Commissioner of Health as District Laboratory Supply Station Custodian.

It was the contention of the administrator of the estate that the State, having knowledge of the incidence of homologous serum jaundice due to the use of pooled plasma, was guilty of negligence in the distribution of the Red Cross plasma and that it was at fault in failing to warn physicians of this danger; that the Red Cross plasma should have been irradiated and that, if the plasma had been so processed, the incidence of the disease would have been materially reduced; further, that the State was remiss in failing to affix a warning label to the plasma carton.

The State Court of Claims of New York dismissed the case, holding that the State was not at fault because the physician had decided, in his judgment, to administer plasma. The danger of serum jaundice known to the State was also well known to the medical profession. It was not until April 1949, some months after the patient had died and after some prior experimentation, that the use of irradiated plasma was generally accepted by the medical profession. There is no warrant, added the court, for the assumption that the State had an obligation to instruct licensed physicians in the proper application of therapeutic agents in common use.

RELEASE SIGNED IN ADVANCE BY BLOOD DONOR IS HELD VALID.[3]—For the first time a court has passed upon the validity of a release signed by a blood donor in advance of the donation of blood.

At the time in question, as well as on several previous occasions when he had given blood, he signed a statement exculpating the commercial blood supplier from any consequences from the giving of the blood and released any claims that he might have "by reason of any matter relative or incident to such donation of blood." He claimed that he suffered injuries due to negligence in not properly caring for him after he gave blood; that the release was against public policy.

The court did not agree with his contention. There are several well defined classes of cases, said the court, where similar types of releases have been declared against public policy and unenforcible. For example, an employee cannot be held to a release given to his employer relating to injuries resulting from his employment, because there must be no relaxation of the rule of law that imposes the duty of care by the employer towards the employee. Similarly, where the relationship involves a public service, it is against public policy for the public service to exempt itself from liability. The basis of this rule is that the parties are on an unequal footing. However, a blood donor does not come within any of these exceptions. He does not have to give his blood. He voluntarily chooses to do so.

3. Boll v. Sharp & Dohme Inc., Supreme Court, New York County, Special Term, Part III, Hecht, J., *New York Law Journal*, Sept. 17, 1951, p. 501.

He is not employed in the usual sense of the relationship. Rather, he is an independent contractor who could give his blood or not as he wishes, depending on the consideration offered by the buyer. The defense that the blood donor signed a release in advance of the donation is sufficient in law.

IT IS NOT MISCONDUCT FOR FOREMAN OF JURY TO CONSULT ASTROLOGIST IN MALPRACTICE CASE.[4]—A case for malpractice involving the death of a patient was tried before a twelve man jury, and a verdict was returned in favor of the physician. Nine of the jurors, the minimum number required in a civil case, signed the verdict. A motion for a new trial was made on the grounds of the misconduct of the jury and irregularity of the court and jury. One of the jurors who failed to sign the verdict testified that the foreman stated that he had consulted an astrologist with the date of the birth of and the time that the deceased was brought to the hospital to be operated upon and that according to the stars "the doctor had two strikes against him in operating at that time on the man." The motion for a new trial was denied, because the foreman's discussion of astrologic conditions pertaining to the operation was not such misconduct as would warrant the granting of a new trial.

FAILURE TO X-RAY TO LOCATE BROKEN HYPODERMIC NEEDLE HELD NOT TO BE NEGLIGENCE.[5]—On account of the fact that the patient had some of her organs removed, it was necessary for some years to inject from time to time a fluid of some character into her body. Generally this had been done by means of a needle inserted in the left arm within a given area. While she was in the hospital, she believed that one of the nurses there had broken and left a part of a hypodermic needle in her arm. Without making a roentgenogram, the physician operated but found no needle. On subsequently making a roentgenogram, he found a part of a needle, which he removed by another operation.

Several physicians testified that, when the pain is localized to the outer surface in a given area, the practice of probing that area to locate a foreign object is followed by many physicians. Although a roentgen examination would be the best way to determine the existence of the foreign substance, probing was considered a proper method by many good physicians in the vicinity. The physician, therefore, was not guilty of malpractice.

4. Hutchinson, Admx. vs. Laughlin, Jr., 19 C.C.H. Neg. Cases, 753, Ohio. May 28, 1951.

5. Gresham vs. Ford, 19 C.C.H. Neg. Cases 747 reversing 18 C.C.H. Neg. Cases 149. Tenn., June 16, 1951.

SERUM ALBUMIN

(Continued from page 239)

This was the second time in my experience that such gratifying results were obtained with calcium chloride and the first occasion that I have had to observe the beneficial effect on cerebral edema of the administration of serum albumin.—SISTER M. YVONNE, R.N., St. Francis Hospital, La Crosse, Wis.

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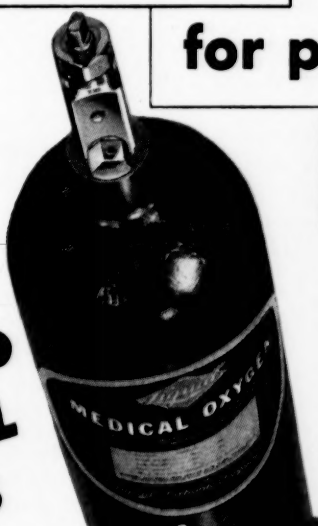

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ABSTRACTS

Bloxsom, A.: Resuscitation of the newborn infant; use of the positive pressure oxygen-air lock. J. Pediat. 37:311-319, Sept. 1950.

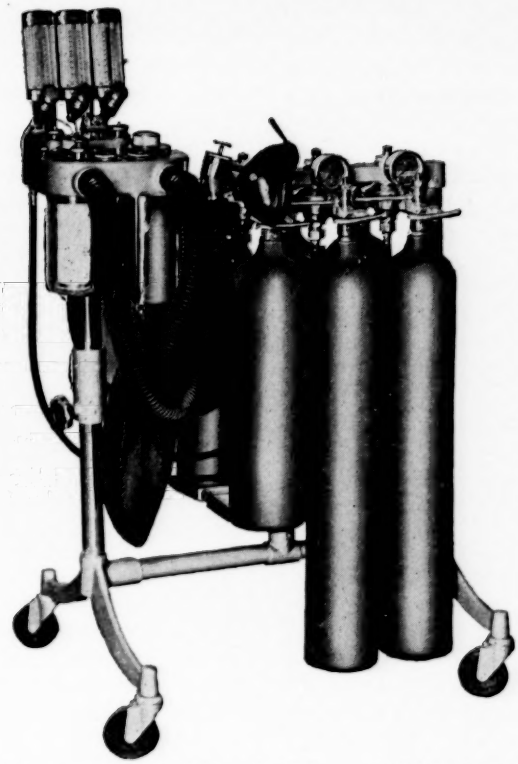
"At the present time there is much to be desired in the resuscitation of the asphyxiated newborn infant. Instrumentation, as the insertion of tracheal catheters or ventilation with air and oxygen, may lead to perforation. Bronchoscopic examination and aspiration affords complete relief only from six to eight hours after instrumentation. Mouth-to-mouth breathing is not only strenuous but carries a risk of infection to the infant . . . . A new method and means of resuscitation and oxygenation of the asphyxiated newborn infant has been used under my direction at the St. Joseph's Maternity Hospital in Houston, Texas, since Jan. 4, 1950. The theory upon which the method is based is that resuscitation of the asphyxiated newborn infant is managed best by continuing in as far as possible the mechanics of labor. It is my belief that labor serves a twofold purpose. The obvious purpose is the delivery of the infant. The second purpose, and I believe as important as the first purpose, is the conditioning of the infant to promptly initiate his respirations.

"Briefly, the mechanism of my method in following that of labor is to provide the infant with heat, humidity, lack of handling, and oxygen and carbon dioxide pressure gradients for the favorable handling of those gases. In addition the expansion of gases is utilized for the expression of fluids and secretions in the pulmonary tree. A full report will be made later on this phase of the resuscitation of the asphyxiated newborn infant. A satisfactory method of total oxygenation for the newborn asphyxiated infant has been found to occur when the infant is placed in a positive pressure oxygen-air lock and the pressure cycled between 1 and 3 pounds at one-minute intervals. The means for employing total positive pressure and cycling those pressures in a manner similar to labor is an air lock designed to contain the asphyxiated infant as soon as signs of asphyxia appear . . . .

"At this time it appears from three of our premature infants who have been processed in this lock that an increased air pressure will play an important part in the life of approximately 12 per cent of the asphyxiated premature infants . . . . The mortality rate in a large maternity hospital has been lowered approximately 25 per cent from a slight reduction in the premature delivery rate and the use of the positive pressure oxygen air lock in resuscitating asphyxiated newborn infants."

Rees, G. J.: Anaesthesia in the newborn. Brit. M. J. 2:1419-1422, Dec. 23, 1950.

"In the past there has been a tendency to adapt to infants those methods of anaesthesia which have proved to be of value in adults. The time has come to consider the problem of anaesthetizing the newborn in relation to their peculiar physiology. During early life the ribs of an infant are disposed almost horizontally



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when the infant is in the erect position. Movements of the ribs can therefore produce only insignificant effects on the capacity of the thoracic cage, and costal respiration is practically impossible. . . . In addition to the relatively poor mechanism for its ventilation, the neonatal lung itself is a comparatively rudimentary structure. The area available for respiratory exchange is small in comparison with that of the adult lung. . . .

"The infantile tracheo-bronchial tree is to some extent adapted to function in these circumstances, and the area of the cross section of the trachea of the newborn infant per unit of lung volume is twice that at 13 months. The sagittal diameter of the trachea of the neonatal infant is variously quoted as 3.6 to 5.7 mm. and of the adult as 15 to 20 mm. The diameter of the adult trachea is four to five times greater than that of the infant. If the forces governing the rate of flow of gases through the trachea follow Poiseuille's law, it would follow that an increase in the rate of flow in the child's trachea would produce an effect on the resistance to respiration 4^4 times greater than the increase in resistance produced by the same increase in the rate of flow through the adult trachea. In other words, if an increase in the rate of flow through an adult trachea increases the resistance to respiration by, say, x, the same increase in the flow rate through an infant's trachea would increase the resistance by 256x. On theoretical grounds, then, it is desirable that any technique employed for anaesthetizing young babies should not tend to increase the respiratory volume per minute, and should, if possible, reduce the amount of mechanical energy required for pulmonary respiration. In addition to these mechanical differences between adult and neonatal respiratory systems, there seem to be certain differences in the sensitivity of the respiratory centre. . . .

"The immature state of the neuromuscular system in the newborn eliminates some of the problems which are met with in adult anaesthesia. The adult type of reaction to the irritation of an endotracheal tube under light anaesthesia is not seen in infants. The so-called 'bucking' is impossible in children under 3 months of age, because until this time the cervical muscles are not capable of raising the head from the pillow. The only sign of irritation of the trachea under light levels of anaesthesia is a disturbance in the rhythm of respiration. Similarly, deep levels of anaesthesia or heavy curarization is not necessary to produce muscular relaxation, because muscle tone is virtually non-existent in the newborn. . . . This ease with which the neonatal lungs can be inflated, combined with the small reduction in blood CO_2 required to produce acapnia, permits easy control of the respiration in young infants. In this respect the behaviour of the lightly anaesthetized infant bears a striking resemblance to the curarized and anaesthetized adult. Control of the respiration is extremely desirable in infants because it relieves the respiratory muscles of their whole load. . . .

"In the newborn . . . control of the respiration is easily ob-

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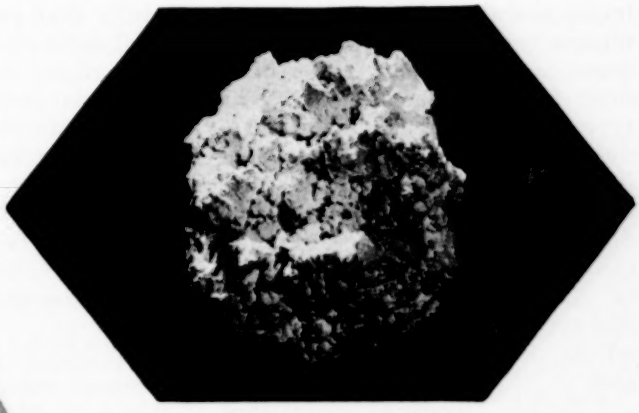

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tained at light levels of anaesthesia without the use of relaxants. . . . In view of the desirability of keeping the patient's respiratory activity at minimal levels and the relative absence of muscle tone, cyclopropane would seem to be an ideal anaesthetic drug for neonatal patients. The type of respiration which it produces would minimize the pushing out of the abdominal contents by the movements of the diaphragm, and the lack of muscle-relaxing properties would not be disadvantageous. There are, however, certain other effects which, I feel, render it undesirable.

"During surgical operations there is undoubtedly a greater loss of blood from those patients who are anaesthetized with cyclopropane, and this becomes a point of major importance in choosing an anaesthetic agent for a patient whose total blood volume is 300-400 ml. Prolonged administration of this drug to very small infants seems to produce in the early postoperative period a shock picture comparable to that often seen after its use in adults. For these reasons I consider that cyclopropane has little value in anaesthesia for the newborn, and that diethyl ether is the principal anaesthetic agent of choice, provided that the respiratory effect is reduced by controlled respiration produced by hyperventilation. . . .

"The operative risk in newborn infants at term is slight, but it increases rapidly during the first week of life. . . . Some authorities have recently recommended that premedication of very young infants with morphine should be done. . . . Atropine should be given in all cases, and a dose which can be used on all newborn cases is 1/200 gr. (0.32 mg.). . . . There are certain anatomical differences between the largest of newborn infants and adults that produce greater technical difficulties [in intratracheal intubation] in the former. The infant larynx occupies a higher position in the neck in relation to the vertebrae, and the axis of its lumen tends to pass forwards as well as downwards. With the descent of the larynx which takes place in later life the forward angulation disappears."

UNNA, K. R.; GLASER, K.; LIPTON, E., AND PATTERSON, P. R.: Dosage of drugs in infants and children. Atropine. Pediatrics 6:197-207, Aug. 1950.

"Data available in the literature . . . appear inadequate to support such assumptions as a change in sensitivity to atropine depending on age or the existence of a 'physiological vagotonia' of the infant. The paucity of experimental data is apparently responsible for the wide variation in the recommended doses and the often expressed uncertainty about the proper dose of atropine in small children. The need for such information prompted the present investigators to initiate studies on the efficacy of atropine and other autonomic drugs under controlled conditions in normal children of different age groups. . . . The minimal effective dose (MED) of atropine was determined by its effect in suppressing sialorrhea elicited either mechanically by chewing gum and/or pharmacologically by subcutaneous injection of methacholine. Variations in individual susceptibility to atropine are large in all age groups and independent of the

route of administration (oral, hypodermic). The average MED/kg. body weight following oral administration is somewhat smaller in infants of 1 to 12 months and children from 21 to 36 months (0.16 and 0.14 mg./kg., respectively) than in older children in the age groups of 3 to 6 years and 6 to 12 years (0.22 and 0.20 mg./kg., respectively). Comparable results are obtained by hypodermic administration.

"The ratio between the MED by mouth and the MED by hypodermic injection is approximately 3:1 in all age groups. The determination of the susceptibility of children of various ages to atropine fails to adduce evidence supporting the assumption of an increased resistance to atropine or of a physiologic vagotonia in infants. . . . The calculation of the dosage of atropine by body weight is recommended."

SARNOFF, S. J.; MALONEY, J. V., JR., AND WHITTENBERGER, J. L.: Electrophrenic respiration. V. Effect on the circulation of electrophrenic respiration and positive pressure breathing during the respiratory paralysis of high spinal anesthesia. Ann. Surg. 132:921-929, Nov. 1950.

"The depression of respiration that occasionally occurs with spinal anesthesia requires prompt and adequate treatment if the ill effects of hypoxia are to be avoided. . . . This article will deal with the effect on the circulation of positive pressure breathing during high spinal anesthesia. An attempt will then be made to compare positive pressure breathing and electrophrenic respiration under these circumstances. . . . An attempt was made to imitate conditions attending the respiratory paralysis and circulatory collapse that accompany an unexpectedly high spinal anesthesia, insofar as these could be obtained in the anesthetized animal. . . . The first experiment was aimed at testing the efficacy of electrophrenic respiration in the dog subjected to respiratory paralysis and the resulting anoxia which led to clearly established cardiac insufficiency. . . .

"In other experiments, after bringing the spinal anesthesia to the point of respiratory paralysis, endotracheal insufflation was applied at pressures of 5, 10, 15, and 20 cm. of water. Throughout these experiments an attempt was made to imitate the type of endotracheal insufflation as observed and practiced in the operating room. . . . Intermittent positive pressure breathing with 15 cm. water was selected for comparison with electrophrenic respiration in regard to the effect on the circulation. . . . The precise nature of the mechanisms by which electrophrenic respiration elevates blood pressure and cardiac output while positive pressure breathing depresses the circulation has not been critically examined. It would seem reasonable to assume, however, that positive pressure breathing retards flow in the great veins, while electrophrenic respiration has the opposite effect. The practical consideration in the evaluation of these technics is that the basic desideratum in this type of catastrophe is adequate ventilation. The authors do not agree with the contention that circulatory collapse per se is the cause of death in high spinal anesthesia if the horizontal or head-down position is maintained and if the circulation is not otherwise embarrassed. . . .

"Death during high spinal anesthesia is due primarily to the anoxia following respiratory paralysis rather than to primary circulatory collapse in the normal dog. Further depression of the circulation is brought about by positive pressure breathing during high spinal anesthesia and is proportional to the pressures applied in the airway. Adequate ventilation is the basic requirement during the respiratory paralysis of high spinal anesthesia. When this is accomplished by means of positive pressure breathing, the circulation is depressed, whereas electrophrenic respiration elevates the blood pressure and, presumably, the cardiac output."

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PULMONARY VENTILATION

(Continued from page 202)

of obstruction can occur. A patient returned to bed with an airway in place rouses enough to reject it. The first postoperative dose of a narcotic permits reestablishment of severe obstruction, but the labored respiration goes unheeded while the airway lies unnoticed at the bedside.

Summary

The challenge of pulmonary ventilation is a challenge to the *anesthetist* and translated into practical terms requires: (1) a recognition of the need for pulmonary ventilation; (2) a recognition of the anesthetist's responsibility in maintaining continuous and adequate pulmonary ventilation; and (3) an extension of that responsibility to include education of all personnel into whose hands the patient falls during the preoperative period, in the operating room, and throughout the postoperative recovery up to the point when his reflexes have so emerged from their induced depression that they can again care for this important function.

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BOOK REVIEWS

ESSENTIALS OF PHARMACOLOGY AND MATERIA MEDICA FOR NURSES. By Albert J. Gilbert, M.D., Instructor of Pharmacology, Aultman School of Nursing, Canton, Ohio, and Selma Moody Brawner, R.N., Major, Army Nurse Corps, Walter Reed General Hospital, Washington, D.C. Ed. 3. Cloth. 343 pages, 20 illustrations. St. Louis: C.V. Mosby Co., 1951. $3.75.

This volume seems to have great value for nurses who are interested in the study of anesthesia. Chapters V and VI in particular give an excellent and concise summary of the drugs of interest to anesthetists. A brief introduction to the chapters reviews the anatomy of the nervous system. The correlation of this material with the subsequent discussion of the pharmacologic effects of drugs makes an effective method of teaching. The responsibilities of the nurse in connection with the use of narcotics is an often neglected phase of teaching; these responsibilities are here clearly outlined. Throughout the text suggestions for good nursing care in connection with the use of drugs make this volume of practical value rather than "just another list of drugs."

Chapters VII, VIII, and IX—covering drugs acting on the circulation, the blood, and the respiration—are also of special interest to anesthetists. An appendix contains a list of doses of important drugs, fourteen rules for giving drugs, Latin abbreviations, lists of weights and measures, and suggestions for study.

A SYNOPSIS OF ANAESTHESIA. By J. Alfred Lee, M.R.C.S., L.R.C.P., M.M.S.A., D.A., F.F.A., R.C.S., Consultant Anaesthetist to General Hospital, Southend; General Hospital, Rochford; Runwell Hospital; King George Hospital, Ilford. Ed. 2. Cloth. 354 pages, 66 illustrations. Baltimore: Williams & Wilkins Co., 1950.

The second edition of this popular book has been printed only three years after the first edition. Many of the advances that have developed during those three years are included in the same concise style as was used in the first edition. The book contains a wealth of information in compact and lucid form. Drawing material from many sources, the author has summarized the "current teaching and practice" of anesthesia. The book does not supplant other texts but will be useful for reference and review.

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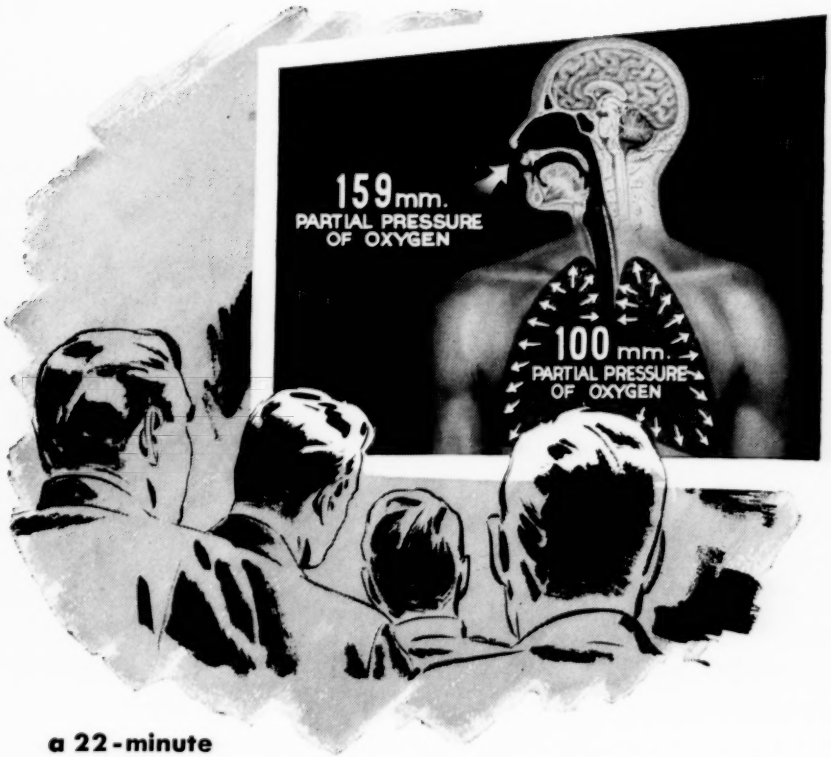

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